LABORATORY AND WORKBOOK ACTIVITIES

IN

BIOLOGY

To Accompany BIOLOGY FOR BETTER LIVING

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TO THOSE WHO USE THIS WORKBOOK

Someone has defined learning, as it often appears to take place, as a process in which ideas from the teacher's notebook are transferred to the student's notebook or workbook without passing through the minds of either teacher or student.

A workbook can be of little help in learning if it functions chiefly as a notebook. This one does not. But, whether or not this workbook helps or hinders you in really learning depends pretty much upon how you use it. We have constructed it in the way that might help you most in studying problems which interest you, and in arriving at conclusions which are based upon evidence that you, yourself, discover through reading, through observing, and through experimenting. But do not think that your work in biology consists merely in performing the activities that are suggested. Biology is the study of life. In a real sense you already have studied biology, for you have been a student of life as you have dealt with the problems of living that you have met every day. Work in biology offers an opportunity to study many problems of living. Work in biology will be of value to you, and fun too, to the extent that you work reflectively and scientifically. We hope that this workbook will help you to increase your ability so to work. Never go through the motions of doing experiments or engaging in activities without making sure you *know the reasons for doing them*. Never answer questions or write your conclusions to problems without *thinking them through*. Never form conclusions that you are unable, or unwilling, to defend with reason.

In order to help you study biology in a scientific way, we have organized this workbook somewhat in the same way that scientists generally work. In most of the chapters we have:

1. Presented a number of problems that seem important enough to be considered.
2. Left space for you to give your present best answer to these problems. In most cases you will have some information upon which you may draw in answering them. This preliminary self-checking will, therefore, permit you to take stock of what you already know. If you have no information upon which to draw, be sure to make the most intelligent guess that you can.
3. Left space for you to indicate other problems that seem to you to be worth considering.
4. Listed, near the beginning of the chapter, books that you may find enjoyable and profitable reading in solving problems that seem important to you.
5. Suggested numerous activities, projects, and investigations that you may wish or need to do in order to understand and solve these problems. More activities than you may wish to do are included so that you and your teacher may select those that seem to be of the most value to you.
6. Afforded an opportunity for you to test yourself in order to determine the extent to which you really have thought through important ideas and concepts in each section.
7. Given you opportunity to reconsider the problems that were suggested at the beginning of the chapter. The scientist works by thinking through problems until he understands their nature. Usually, once he understands the problem clearly, he is able to make a rather intelligent guess (hypothesis) as to its solution. He then is able to study, experiment, and observe in order to determine whether or not his hypothesis is a correct one or whether other hypotheses are more in keeping with the facts that he discovers. On the basis of these facts, he forms certain conclusions on which he is willing to base his thinking and action, until more facts give him [illegible]
8. Provided space, in the last section in most chapters, for you to write careful summaries of the problems explored. These summaries are the conclusions and generalizations—the important or big ideas—that your workbook work has helped you to acquire.

You will consider many important and interesting problems in biology. But the values in studying this subject are not only in facts that may be learned and remembered. Chief values lie in learning constantly to improve methods of work, of study, and of thinking. Unfortunately, many of the facts will be forgotten—even the important ones. But if you have learned to be scientific in your methods of work, in your thinking, and in your dealing with other people, you need not be too concerned about your inability to remember certain facts. You will have discovered a method—the best method man has ever developed—of finding facts when you need them, and of thinking clearly upon the basis of those facts. Let this, then, be your goal in the study of biology: To study those problems of life that are important and interesting, and to study them increasingly by reflective and scientific methods of work.

R. Will Burnett
Paul E. Blackwood

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(Upper) George School, George School, Pa.
(Middle) Gregor from Monkmeyer
(Lower) Meisel from Monkmeyer

(Upper) Cincinnati Bd. of Ed. and "Times Star"
(Middle) Aigner from Monkmeyer
(Lower) Russell Sage College, Troy, N. Y.

(Center) Bradford Junior College, Bradford, Mass.

Can you identify each of the laboratory activities pictured on this page?

TO HELP YOU IN YOUR STUDY OF BIOLOGY FOR BETTER LIVING

Certain tools, methods of work, and learning aids will help you in many parts of your work in biology. For easy reference, the most important of these are suggested in this section. You have been told that biology is the study of life. Therefore, you will want to understand methods of work which will allow you to study life as it is revealed by living things in a variety of situations. Biology is also a science. Therefore, you will want to understand the use of certain tools and procedures that will help in making your study of life a scientific study.

CARE OF LIVING THINGS IN THE LABORATORY

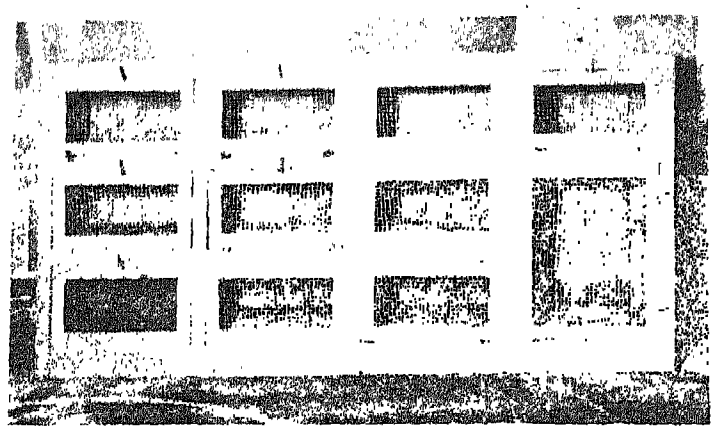
1. Mammals

(1) *Housing.* White rats, mice, guinea pigs, and rabbits, besides making interesting pets, are useful in the biology laboratory in many ways. They may be used in diet experiments, in breeding and genetics experiments, or for dissection.

Cages for living animals can be made easily and cheaply. Relatively small wire cages or wooden boxes, covered with wire on one side, are satisfactory. However, sufficiently large cages or compartments should be provided so that the animals have room for exercise. Females about to bear young should be provided with separate compartments. False bottoms in all cages are desirable, for cleaning purposes. Dishes for water and food should be provided.

A multiple compartment cage is useful for it provides room for various types of animals, including the larger ones that may occasionally be brought into the laboratory. The one pictured below was built by students in a biology class.

This cage is constructed from 2″ by 2″ boards and is covered by the wire screen known as hardware cloth. It has ten compartments, size 20″ by 20″ by $11\frac{1}{2}$″; one compartment, size 20″ by 20″ by 22″. The hardware cloth for ten of the compartments has a $\frac{1}{2}$ inch mesh; for the other compartment, $\frac{1}{4}$ inch mesh.



Courtesy Biology Students, Concordia, Kansas

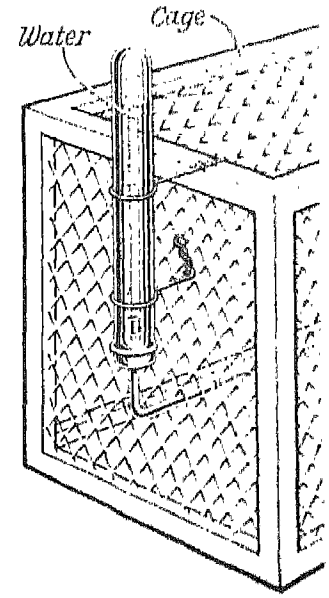
(2) *Feeding.* Staple foods are dry bread, grains, meal, and fresh vegetables. A complete diet may be made up as follows:

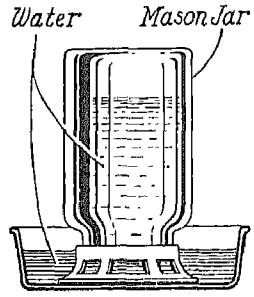
32 parts powdered milk	1 part salt
60 parts corn starch	2 parts calcium carbonate
3 parts lard	2 parts yeast

40 drops cod-liver oil per 1,000 grams of diet

Turtox Service Leaflet No. 49, "Nutrition Experiments," obtainable free from the General Biological Supply House, 761 East 69 Place, Chicago, Ill., suggests diets for diet experimentation.

Provide fresh water at all times. This may be provided by the type of water pan used to water chickens and obtainable at most hardware stores. See diagram at the left. A somewhat better water dispenser may be made from a large test tube which is fitted with a one-hole rubber stopper through which is run a bent glass tube of large diameter. The end of the glass tube should be flamed so that rough edges will not cut the animals securing water. This type of water dispenser should be fastened to the side of the cage, as indicated in the diagram at the right.

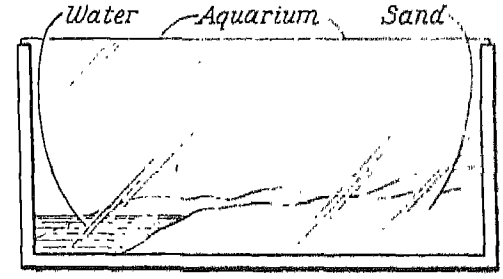




(3) *Disinfecting*. This is important. Clean the cages daily and disinfect them at least once a week. Cages may be effectively disinfected by spraying them with a disinfectant made by diluting a teaspoon of eucalyptus oil in one cup of water.

2. Reptiles

(1) *Housing*. Use a box or cage the bottom of which is covered with sand. A shallow pan of water should be provided and should be settled into the sand so that its edges come flush with the sand around it. An even better method is to place sand in an aquarium in the manner indicated in the diagram so that water is at one end and a shelf of clean sand is at the other end.



Reptiles should be provided with a place of retreat. Place pieces of bark or twigs and dry grass in such a fashion that the animal can burrow under them. In cooler climates, reptiles hibernate. Even in the classroom they may appear sluggish and unresponsive during the winter months. Place the cage so that part of it receives sunshine at least one hour a day. Change water regularly.

(2) *Feeding*

(a) Turtles. Feed turtles once a week. Drop food into the water. Food should be small live animals such as earthworms, insects, or snails until the turtle becomes accustomed to its surroundings. Then try chopped meat.

(b) Lizards and snakes. It is particularly important to feed snakes small live animals such as those suggested above because snakes will seldom eat food that is not moving.

3. Frogs and other amphibians

(1) *Housing.* Same as that suggested for reptiles. Place flat stone in water so that top reaches above water an inch or two.

(2) *Feeding.* Same as that suggested for reptiles.

4. Butterflies, moths, and caterpillars

(1) *Feeding.* Caterpillars eat green leaves. Try to provide leaves or grasses on which caterpillar was found. Otherwise experiment with various types of leaves or green vegetables until one is found that will be eaten. Provide a syrup of sugar and water for moths and butterflies. Some adult moths do not have mouth parts.

5. Ants

(1) *Housing.* Making sure to include queen, place an entire ant colony, including the earth from colony, in a large battery jar or other glass receptacle and wrap closely with heavy black paper. Cover the top with fine mesh screen or thin cloth. Place bread crumbs and a syrup of sugar and water in receptacles on the top of the earth. In a few days remove the black paper from the outside of the glass jar. You will probably find that the ants have built tunnels along the glass on the inside of the jar so that colony activities may be observed.

FIELD TRIPS

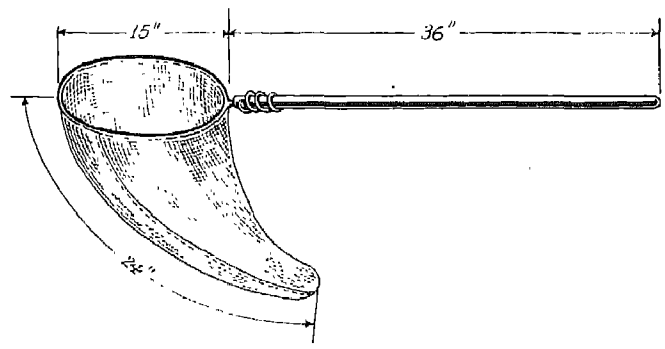
Field trips vary in their purpose, in their extent, and in the amount of preparation required for their success. However, regardless of their nature, all field trips are taken for definite purposes. To get the greatest profit and enjoyment from field trips, you should always do the following things:

1. Determine clearly the purpose of the trip. Know what you intend to gain from it. This will mean preliminary discussions and notetaking.
2. Always provide yourself with notebook and pencil. Take careful observations even if the main purpose of the trip is collection of specimens.
3. Dress appropriately to insure bodily comfort.
4. Assemble and take along all the equipment you will need.
5. Upon returning, before the trip gets "cold," review the notes and observations so as to be able to discuss the trip intelligently with members of the class.

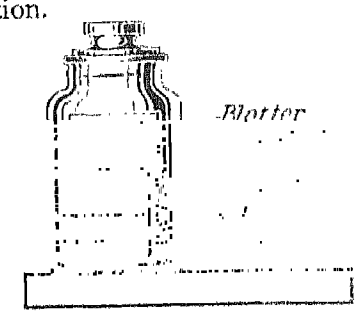
INSECT COLLECTING

Collecting equipment

(1) *Nets.* Nets should be provided both for the collection of the swifter moving insects and for "sweeping" through grass. A good collection net may be made from a light broom handle, stout wire, and cheese cloth. A heavier net should be made for sweeping. The diameter of the net should be 12 to 15 inches, and the depth of the net should be about 24 inches. See diagram below.



(2) *Killing jars.* Ether or chloroform poured on a small piece of absorbent cotton, and placed at the bottom of a small, airtight jar may be used for occasional trips, but these fumes make insects brittle. A better killing jar is made with potassium cyanide. However, *this chemical and its fumes are deadly poisonous.* So handle with extreme caution.

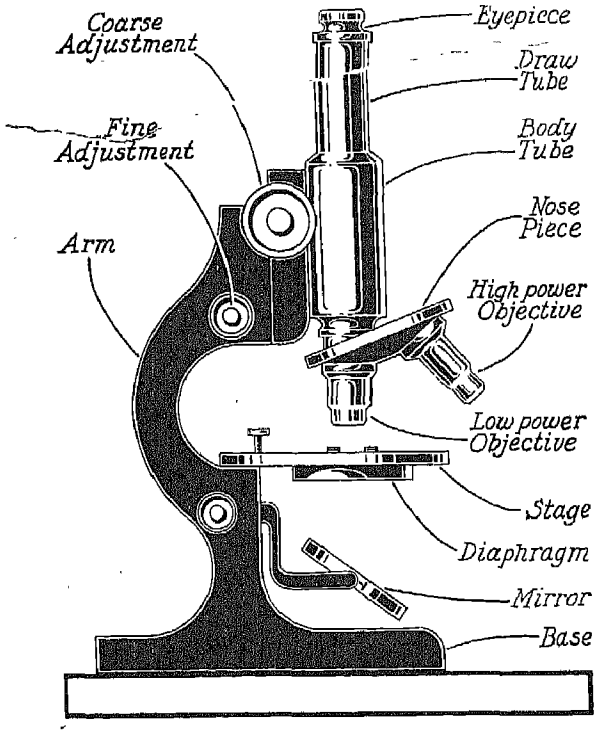


Make the jars as follows: Secure wide mouth jars with tight fitting lids. Place $\frac{1}{4}$ inch of potassium cyanide in the bottom of the jar and cover with $\frac{1}{4}$ inch of fine sawdust. Cover this with $\frac{1}{2}$ inch of plaster of Paris and allow it to dry. Cover the plaster of Paris with a section of blotting paper which will absorb the juices from insects placed in the jar. Keep the jar tightly covered. Label jar: POISONOUS! DO NOT INHALE FUMES!

USE AND CARE OF MICROSCOPE

You may have occasion to use the microscope many times in your work in biology. The compound microscope is a delicate and expensive instrument. Therefore, it is important that your learn to use it correctly and to care for it intelligently.

Study the diagram below. Observe the following rules every time you work with a microscope.



1. Always handle the instrument with care. Carry it in an upright position by placing one hand around the arm and the other under the base.
2. Don't touch the eyepiece or objective lenses. They should be cleaned only with lens paper.
3. Never screw the tube down while looking through the microscope. You may jam the objective lens into the slide, possibly ruining the expensive slide and scratching the lens. To focus the microscope, first screw the tube down, looking at the side of the objective lens, until it is close to the object being studied. Then, looking into the eyepiece, bring the tube up slowly, using the coarse adjustment until the image comes into clear focus. Then use the fine adjustment to gain clearest focus.
4. Keep both eyes open. If you close one eye, and squint into the tube, eye strain and fatigue may result. Practice keeping both eyes open. If you place the instrument on a plain desk or table top, you should be able to train the eye not viewing through the instrument to lose focus.
5. Adjust the amount of light entering the tube by moving the mirror back and forth. Ordinarily the concave surface should be used. Many microscopes have an iris, or diaphragm. If your instrument has one, start with it wide open. Then close it gradually until the best image is obtained.

Name _____ Date _____ Class _____

INTRODUCTORY UNIT. LIVING THINGS AND HOW WE LEARN ABOUT THEM

Chapter 1: Biology—A Study of Life

Although you are already a student and observer of life, biology as a school subject is for you a new study. You probably noticed that one definition for Biology is given in the chapter title for this chapter. Think of the tremendous "reach," or scope, of Biology as there defined. Perhaps you have already studied some subjects that, in the light of that definition, appear to you to be branches of Biology.

I. DRAWING ON WHAT YOU ALREADY KNOW

Read each of the following questions thoughtfully. On some of them you probably now have some information. Write your best present answers in the light of that information. If the question presents a problem completely new to you, make the most intelligent guess that you can. Intelligent guessing is a part of the scientific method. It is entirely in keeping with the preliminary self-checking that you will find in Section I of each chapter in this workbook.

1. What studies or fields of work can you suggest as probable branches of biology?

_____

_____

2. What values do you see in the study of biology? Answer this in terms of what you personally hope to gain from your work in this course. _____

_____

_____

_____

3. Could you distinguish between living and non-living things from the standpoint of movement? From the standpoint of growth? From the standpoint of increase in numbers? Write your best present answer to each part of this question and explain briefly why you answer as you do. _____

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4. Could one correctly speak of the "biology of a river"? Why, or why not?

5. In the space below add any other questions or problems concerning the nature of your work in biology or the nature of the field of biology that you wish answered.

II. EXPLORING

These books represent a minimum list of those which you might read with profit and enjoyment. A longer list is included at the close of Chapter 1 in BIOLOGY FOR BETTER LIVING. Determine what ones are available in your library. Use all references that are relevant, authoritative, and interesting to you.

Peattie, Donald C., and Aymar, Gordon. *This is Living.* New York: Dodd, Mead and Company, 1938. A beautiful book, with photographs of animals and plants of many lands.

Life in America Series. Works Progress Administration. Write to your State Director, Works Progress Administration, for information about any volumes of this series that deal with your community. The series is unusually interesting as it deals with local peoples and animals. The volumes vary as widely as people's interests vary—ranging from *Who's Who in the Zoo*, a collection of 200 photographs of animals, to *These Are Our Lives*, a collection of life histories from the southern states, told by the individuals themselves.

Kitson, H. I. *I Find My Vocation.* New York: McGraw-Hill Company, Inc., 1937. An excellent discussion of some of the vocational possibilities for young people. Some of the vocations discussed require a knowledge of biology.

Sanderson, Ivan T. *Living Treasure.* New York: The Viking Press, 1941. An exciting book about the adventures of Ivan and his wife in Central America.

Peattie, D. C. *Green Laurels.* New York: Simon and Schuster, 1936. In an unusually exciting way, Peattie tells the life story of several scientists who have made outstanding contributions to biology.

III. DOING AND RECORDING

1. Discuss with the class the meaning of the term biology. If you arrive at a definition acceptable to the group, place that definition in the space below.

Name _____ Date _____ Class _____

2. Perhaps it would increase your understanding of what biology is if you were to determine some of its branches. There are many such divisions of biology. Some of them are listed below. Look up the meaning of these terms in an encyclopedia or dictionary and explain briefly what work is done in each field of study.

Field of Biology	Nature of the work done in each field
Anatomy	
Bacteriology	
Botany	
Embryology	
Genetics	
Hygiene	
Paleontology	
Physiology	

3. You now have some idea of the great scope of biology as a field for study. Many things could be included in your year's work, much more in fact than there will be time for. It would be a good idea to spend two or three days in thinking over and discussing with other class members what you most want to emphasize. Think through some of the situations and problems that you meet in daily living. Browse through your textbook and other references. Then list the areas of work selected for emphasis, after the class has decided upon them. You may want to enlarge or revise the list later on.

4. Observe a cat or a dog, an insect, a human being, a plant, and a stone. List in the column to the left all the behaviors or activities (eating, moving, reacting to stimuli, etc.) by which you judge them to be living or non-living things. Place a check (√) after each of these items found to be present in the object being studied. Place a zero (0) if the behavior or activity is absent.

Behaviors and activities	Cat or Dog	Insect	Human Being	Plant	Stone

IV. TESTING

1. How could biology—the study of life—aid a salesman in his work?

2. How can biology aid you in the life work for which you are preparing? If you haven't decided upon the work you wish to do, choose one field that appeals to you as particularly interesting in answering this question.

V. SUMMARIZING

Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now. How would you now answer those questions that you yourself raised?

Name _____ Date _____ Class _____

Chapter 2: Science—A Method of Obtaining and Testing Knowledge

Man has in his hands a powerful tool to help him live a rich and happy life. This tool is science. Perhaps you have never thought of science as a "tool."

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions, write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have an opportunity to revise these answers.

1. What distinction between magic and science can you suggest? _____

2. Can reliable information be discovered by the use of reasoning alone? Explain. _____

3. How would you describe the method of science? _____

4. What is meant by "the scientific attitude"? _____

5. Who, or what, is a scientist? _____

6. List any problems concerned with science or with other methods of gaining information about which you wish to know more.

II. EXPLORING

Colcord, Joanna C. *Your Community, Its Provision for Health, Education, Safety, and Welfare*. New York: Russell Sage Foundation, 1941. This book was prepared in order to help you learn more about your community. It suggests the important questions you should be able to answer to become intelligently informed about *your* community.

Huxley, Julian, and Andrade, E. N. *Simple Science*. New York: Harper & Brothers, 1935. Chapter I of this very interesting book discusses what science is and how it operates in our lives.

Jaffe, Bernard. *Outposts of Science*. New York: Simon and Schuster, 1935. In clear and forceful statements Jaffe has brought into one book much of the new knowledge of the breathless advance of science.

National Resources Planning Board. *Research—A National Resource*. December 1938. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 50 cents. Discusses the relation of federal government to research.

Thouless, Robert. *How to Think Straight*. New York: Simon and Schuster, 1939. A very readable book, written to help people avoid certain common pitfalls in thinking.

III. DOING AND RECORDING

1. Do people still seek to answer their problems by magical means? Divide responsibility in the class for investigating astrology, palmistry, and the use of ouija boards. After the reports are given and discussed in class, summarize briefly each method of solving problems. Tell whether or not you believe each method represents a belief in magic.

Astrology:

Palmistry:

Ouija board:

Name _____ Date _____ Class _____

2. Explain how you might determine whether or not it is better to plow a furrow (1) up and down a steep slope or (2) following the contour of the slope by each of the following.

   (1) Use of magic: _____

   (2) Pure reasoning: _____

   (3) Observation: _____

   (4) The scientific method: _____

3. Select one great biological scientist about whom you have read and tell how he used the scientific method. _____

4. State chief advantages and disadvantages, as you see them, of finding and testing knowledge in each of the following ways.

(1) Use of magic

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

(2) Pure reasoning

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

(3) Observation

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

(4) The scientific method

Advantages: _____

_____

_____

Disadvantages: _____

_____

_____

Name _____ Date _____ Class _____

IV. TESTING

1. State a personal problem that you have encountered and outline the procedure you would follow in attempting to solve it by the scientific method.

_____

_____

_____

_____

_____

_____

2. Write three words after each of the following terms that describe the real character of that particular way of finding knowledge.

(1) Magic _____ _____ _____

(2) Pure reasoning _____ _____ _____

(3) Observation _____ _____ _____

(4) The scientific method _____ _____ _____

V. SUMMARIZING

1. What revisions or additions do you now wish to make to your answers as you stated them in Section I?

_____

_____

_____

_____

2. How would you now answer the problems which you yourself raised in Section I?

_____

_____

_____

_____

3. Sometimes it is possible to make definite statements regarding the way certain things will act. For example, we say "Water runs down hill." We mean, of course, that if only the force of gravity is acting to pull the water it will run downward. All evidence and facts indicate that this is so. Suppose we have observed only water, milk, oil, and turpentine run down hill, and yet we say, "*All* liquids run down hill." We have made a statement about all liquids based on observations made on only *four* of them. However, we expect the same rule would apply to other liquids. Such a statement we call a *generalization.* A generalization, then, is a statement which expresses a relationship that would for the most part, in most places, under similar circumstances, hold true. What important generalizations or ideas has your study of this chapter about methods of obtaining and testing knowledge caused you to believe to be sound?

What generalizations can you state about magic?

What generalizations can you state about palmistry?

Name _____ Date _____ Class _____

UNIT 1. PROBLEMS OF GOOD LAND USE

Chapter 3: The Soil, Our Heritage: A National Problem

Had you ever thought of the soil in either of the ways suggested in the title for this chapter? The fact that we do not know we face a problem often makes that problem even more serious. Sometimes we awaken to the fact that the problem is ours too late to do a good job of solving it.

I. DRAWING ON WHAT YOU ALREADY KNOW

1. Recall the meaning of the word "biology." At first thought it may seem strange to start out your study of this subject with problems concerning soil. The following exercise will help you see the appropriateness of so doing. After you have filled in as many of the blank spaces as you can, use the space provided at the bottom of the page to justify inclusion of problems of good land use in the study of biology.

Common foods	Direct source from which man secures each food listed—Example: eggs from hens	Source from which each direct source is derived or secures food	Source from which each secondary source secures food (some cases)	Relation of primary source of food to soil
Eggs	hens			
Bread				
Cheese				
Carrots				
Milk				
Nut meats				
Fish				
Oranges				

2. In the space after each of the following questions, write your best *present* answer. You may want to discuss these questions with other members of the class before you answer them.

(1) Some one has said, "Soil and life are twins: neither can exist without the other." Does that mean that life is necessary to soil? _____ If so, how?

_____

_____

(2) Are people who live and work in large cities affected by the fact that soil from American farms is being lost in serious amounts? _____ Are they affected in ways other than those concerned with food supply? _____ Explain why you answer as you do.

_____

_____

_____

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_____

(3) Are there any problems resulting from soil erosion (soil loss) in your community? If so, what are these problems? _____

_____

_____

_____

_____

(4) What procedure would you follow in order to learn more about the problems of soil erosion in your community? _____

_____

_____

_____

_____

(5) Do you agree with the statement: "Poor land makes poor people—poor people make poor land"? _____ What evidence can you give to defend your answer? _____

_____

_____

Name _____ Date _____ Class _____

(6) What other questions or problems concerning conservation of our soil do you wish to have answered?

_____

_____

_____

_____

_____

II. EXPLORING

de Kruif, Paul. *Hunger Fighters.* New York: Harcourt Brace and Company, 1928. Sometimes you fit the crop to the land, sometimes the land to the crop. With wheat and maize, both adjustments have been made, and de Kruif describes them vividly in this book.

McWilliams, Carey. *Factories in the Field.* Boston: Little, Brown & Company, 1939. A factual study of the migratory field worker in California.

Vance, R. B. *Farmers Without Land.* Public Affairs Pamphlet No. 12. New York: Public Affairs Committee, Inc. What are the problems and the hopes of tenants in the Midwest and in the South? Who is responsible for the welfare of the land?

Taylor, Paul S. *Adrift on the Land.* Public Affairs Pamphlet No. 42. New York: Public Affairs Committee, Inc. A narrative picture of the routes taken by migrating farm families, their conflicts along the way, and their hopes of getting land of their own.

Sears, Paul. *Deserts on the March.* Norman: University of Oklahoma Press, 1935. A fascinating description of the land in the United States, with useful suggestions about keeping it at its best.

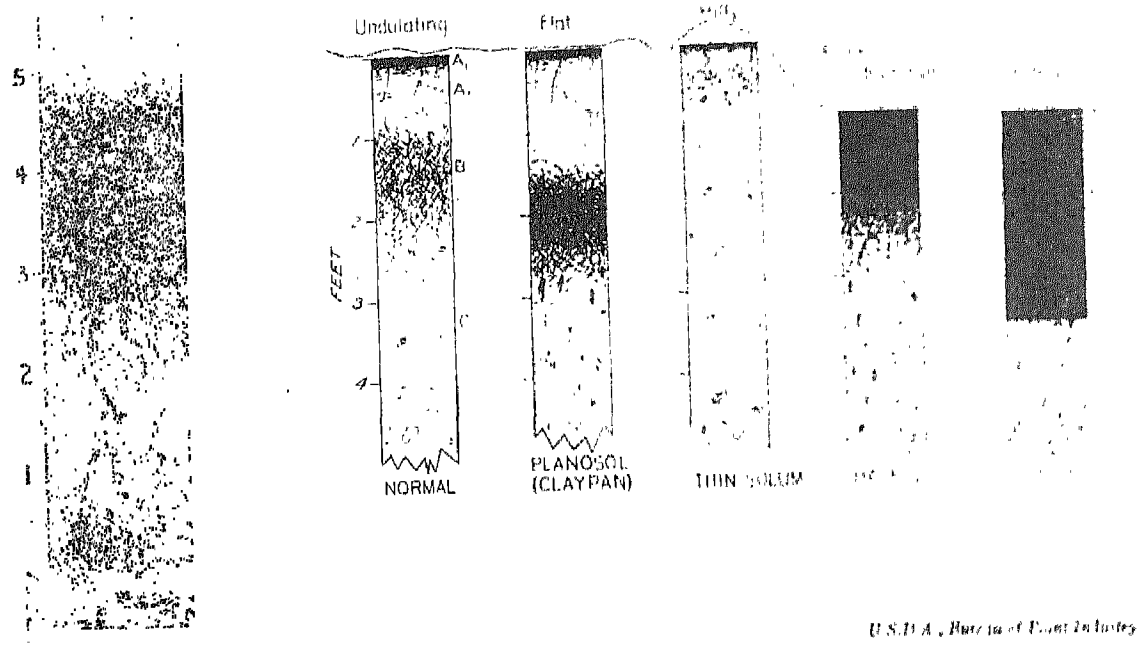
Farmers in a Changing World. U.S.D.A. Yearbook, 1940. Washington, D. C.: U. S. Government Printing Office. See especially Part I, "The Farmer's Changing World," Part II, "Agriculture and the National Welfare," and Part III, "The Farmer's Problems Today and Our Efforts to Solve Them."

U.S.D.A. Miscellaneous Publication No. 60. A price list of publications of the U.S.D.A. Write Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

III. DOING AND RECORDING

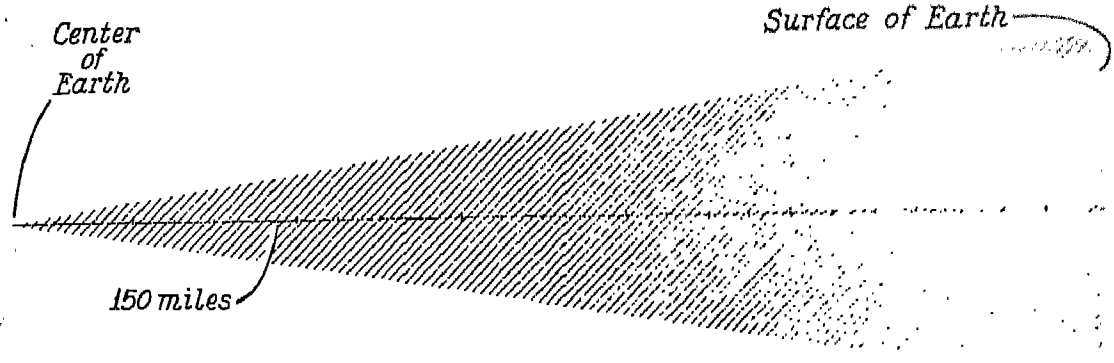
1. Soil has been forming on the surface of our earth since the beginning of time. The soil-profile photograph at the left on the next page is representative of soil types found in the "corn belt" of the Middle West. As the measuring stick in the picture shows, soil layers have been exposed to a depth of nearly five feet. The five diagrams to the right of the photograph show differences in soils that have developed from parent materials similar to those from which the soil in the photograph was developed, but which differ one from another chiefly because of differences in surface relief. "A" represents the part of the soil profile in which life is most active and abundant. The plowed layer of land commonly lies within "A" and includes most of it. "B" is the subsoil, usually marked by heavier texture. "C" is the unconsolidated material below the true soil, and is usually referred to as the parent material. Below "C" is the underlying stratum, which may be hard rock.

Use the five diagrams at the right of the photograph to find an average depth of the soil over much of the "corn belt." A fairly accurate average depth may be found by determining the total combined depths of all the "A" and "B" layers shown, and then dividing that sum by 5. Average depth _____



U.S.D.A., Bureau of Plant Industry

2. You probably found, from the foregoing exercise, an average soil depth of twenty-five to thirty inches for the soil in the five diagrams. Using either number, try to show what that depth would be in comparison to the total distance from the surface to the center of the earth. Use the drawing below, which represents a spherical sector of the earth. Note that each division on the radius stands for approximately 150 miles.



3. Someone has referred to the soil layer as the "epidermis of the earth." How has the foregoing exercise helped you to read meaning into that expression? _____

_____

_____

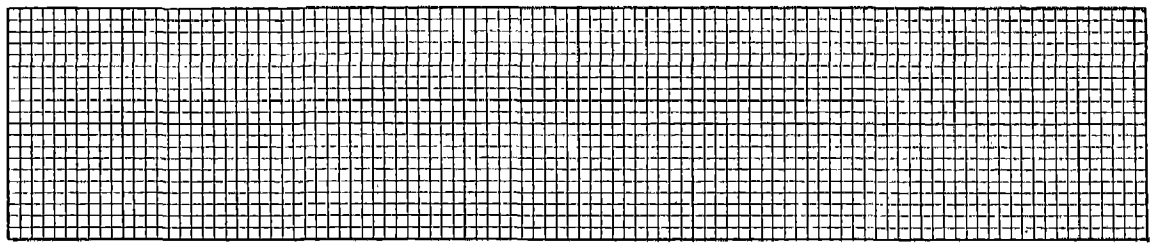
_____

_____

Name _____ Date _____ Class _____

4. During a single storm in northern Mississippi, land under cultivation lost 68,000 pounds of topsoil per acre. How many tons would that be ? _____ Assuming that the earth in this case weighed $62\frac{1}{2}$ pounds per cubic foot, this one storm removed a layer of topsoil equal to one-fifth of an inch. How many such storms would it take to remove ten inches of topsoil, leaving the fields practically denuded? _____ Assuming, again, the occurrence of two such storms in a year, how many years would be required practically to denude these fields? _____

5. The soil over much of the Mississippi Valley has been in the process of formation for many thousands of years. The most recent "age," as geologists figure time, is estimated to be about 25,000 years. Let us take that as a good guess concerning the length of time it has taken to form the soil on the fields referred to in No. 4. Let each tiny square in the grid below represent the number of years that you found for your last answer in No. 4. Using a red pencil, box off the number of squares that would represent 25,000 years—the soil-forming period. Then color black the one square that represents the time needed to wash away (in the particular case cited above) the soil that it took 25,000 years to form. State your conclusions in the space below the graph.



_____

_____

_____

6. Name some of the important factors and influences that have led to excess destruction of America's land in the past. Which of these influences are important today? Place your answers in the spaces below.

Factor or influence	Where was this influence especially important?	Is this influence important today?

7. Using your text and other references, find the information called for below.

   (1) Total land area in the United States: _____

   (2) Approximate amount of croplands: _____

   (3) Approximate amount that erodes badly by present farming methods, or is already seriously eroded: _____

   (4) Approximate per cent of present croplands that could be cultivated without danger of serious erosion if farmers used best farming practices: _____

8. When the land suffers, the people suffer. Using your text and other references, indicate some of the things that are happening to American farmers who live in regions where erosion has been severe. _____

_____

_____

_____

_____

_____

_____

9. Is wind erosion our most serious erosion problem? Explain. _____

_____

_____

_____

_____

_____

10. Field Study

It is difficult to study a problem like that of soil erosion and to gain a clear picture of its nature without actually seeing the problem in your own community. After reading the suggestions and directions on page vii, organize a field trip to see whether or not erosion is taking place in your community. If you will contact your county farm agent and the regional and county offices of the Soil Conservation Service, soil experts probably will be sent to aid you in organizing this trip. Plan the trip carefully and write up notes on erosion as you study it in the field. If you are a good photographer, you may want to make a photographic record of the trip, and prepare, as a project, a photographic record of erosion in your community. Attach your notes or a summary of them to this page.

Name _____ Date _____ Class _____

IV. TESTING

1. During the long ages before man appeared on the earth, the rate of soil formation exceeded the rate of soil removal by only a small margin. We know this to be true because of the relative thinness of virgin soil compared to the long time it has been forming. Six ways in which man has upset the delicate balance between soil formation and soil removal are:

   (1) _____

   (2) _____

   (3) _____

   (4) _____

   (5) _____

   (6) _____

2. Which agent of erosion causes our most serious erosion problems? _____

3. Why should problems of soil conservation be faced by each and every citizen in our country? _____

   _____

   _____

4. In your opinion, what is a good way to get the cooperation of farmers in using the best farming practices? _____

   _____

   _____

5. Why is the problem of soil conservation of great importance to Americans living in cities? _____

   _____

   _____

6. In general, should the people who own the land live on it and farm it? Tell why you think as you do. _____

   _____

   _____

   _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

How would you now answer those questions which you yourself raised in Section I?

2. You learned in Chapter 2 that a generalization is a statement which expresses a relationship that would, for the most part, in most places, under similar circumstances, hold true. To say, as Pare Lorentz did, that "Poor land makes poor people—poor people make poor land" is to make a generalization based upon sufficient observation or evidence to make the statement hold true generally. Can you now, after having studied this chapter, and observed and studied the problems raised, make any generalizations related to, and based on information about, the soil and man's use of it?

Example: City people are as dependent upon soil as are farming people.

Name _____ Date _____ Class _____

Chapter 4: The Formation and Composition of the Soil

Many of you may be living in cities or towns. If so, you may wonder why you should be expected to know anything about the *formation* or *composition* of the soil. After you have solved the problems and done the exercises suggested in this section of your notebook, you should be able to answer that question in a satisfactory way.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Has all soil been formed in the same way? _____ Describe soil formation as you now think of its taking place. _____

2. Can you tell what is meant by topsoil? _____

3. Is the topsoil thick or thin in your community? _____

4. How long, in general, do you think it takes for an inch of topsoil to be formed?

5. How does topsoil differ from subsoil? _____

6. How do you account for soils in different parts of our country differing in color? Some soils are red; others, black; others, yellow; etc. _____

7. List any other questions concerned with the formation or composition of soil that you would like to have answered.

II. EXPLORING

Parker, Bertha Morris. *The Earth's Changing Surface* and *Stories Read from the Rocks*. Evanston, Illinois: Row, Peterson and Company, 1941. These 36-page pamphlets are interesting and well illustrated.

Huxley, J. S., and Andrade, E. N. *More Simple Science*. Oxford: B. Blackwell, 1935. For an excellent simple treatment about soil, see Chapter IV

Croneis, Carey, and Krumbein, William C. *Down to Earth*. Chicago: University of Chicago Press, 1936. An unusually good description of the development of soils and of life on the earth.

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U.S.D.A. Yearbook, 1938. *Soils and Men*. Related Topics (1) "Loss of Soil Organic Matter and Its Restoration"; pp. 347–360. (2) "The Physical Nature of Soil"; pp. 887–896. (3) "Water Relations of Soils"; pp. 897–910. (4) "General Chemistry of Soil"; pp. 911–928. (5) "Soil Classification"; pp. 979–1001.

Agricultural Chemistry and Soils and Fertilisers. Price List 46 37th Edition Washington, D. C.: Superintendent of Documents, U. S. Government Printing Office.

The Land in Flood Control. U.S.D.A. Miscellaneous Publications, No. 331, 1938. The close relationship between soil and water problems is shown to be an important factor in planning for flood control.

III. DOING AND RECORDING

1. In order to gain a better idea of the tremendous amount of time that has elapsed since soil formation began, refer to a geologic timetable in some geology, dictionary, or other reference, and find the number of years since each of the following events occurred.

Event	Estimated number of years ago
Formation of the earth	
Beginning of simple plant life	
Earliest vertebrates appeared	
First land plants	
First fishes	
First dinosaurs	
First flowering plants	
First birds	
Mammals (other than man)	
Appearance of man	

Name _____ Date _____ Class _____

2. Make a survey of some localities in your community to discover the types of soil (sandy, loamy, rocky, clayey, etc.) which are common there. Members of the class should investigate different areas and share findings with the group.

Types of soil	Sources of soil samples

3. Take soil samples from several places in your community to see how deep the topsoil is in various spots. For example, you may take samples from a hillside, from near a river or other stream, from a pasture, from a cornfield, and from the school yard.

Place where soil sample was taken	Depth of topsoil	Place where soil sample was taken	Depth of topsoil

4. Examine particles of various kinds of soil under the microscope. By brief statements and pencil sketches show or describe relative sizes, shapes, etc.

Type of soil	Description of soil particles	Sketch
Rich black soil		
Poor soil		
Sandy soil		
Clay		

5. In the table below, summarize the agents, including living plants and animals, which help in the formation of soil. Tell what evidence you have seen in your community (or nearby locality) of these agents, and indicate location in each case.

Process, agent, or soil-forming factor	Evidence	Location where evidence was seen

6. Insoluble minerals in the soil are sometimes made soluble through the action of acids. To see the action of an acid on one type of mineral, place a small amount of hydrochloric or sulphuric acid on a piece of limestone or marble. Be careful to see that the acid does not touch your skin or clothing. If it does, flush it off immediately with running water.

   What happens to the stone when acid contacts it?

7. The roots of plants are often unable to use minerals in the soil if these minerals are locked up in insoluble forms. This experiment may indicate one way in which small amounts of these insoluble minerals may be made soluble so that they can be used by the plant. Fill a test tube two thirds full of water and add a small amount of phenolphthalein (a chemical indicator). Now add a small amount of a base, such as sodium hydroxide. What happens?

Name _____ Date _____ Class _____

Add a small amount of hydrochloric or sulphuric acid. What happens? _____

_____

Phenolphthalein is used to detect the presence of an acid or a base. On the basis of the foregoing experiment, write in the space below the nature of a test (1) for an acid, and (2) for a base. How could you tell whether you had a base, an acid, or a neutral (neither acid nor base) solution? _____

_____

_____

_____

8. Fill two test tubes two thirds full of water. Add a small amount of phenolphthalein and just enough base to turn the solution pink. Be sure that the color in the two tubes is the same. Now place a growing bean seedling or other small plant in one of the test tubes. Examine at the next class period. What has happened? _____

_____

Explain what you observe. Where did the acid apparently come from? How might this aid the plant if insoluble minerals were near its roots? _____

_____

_____

_____

_____

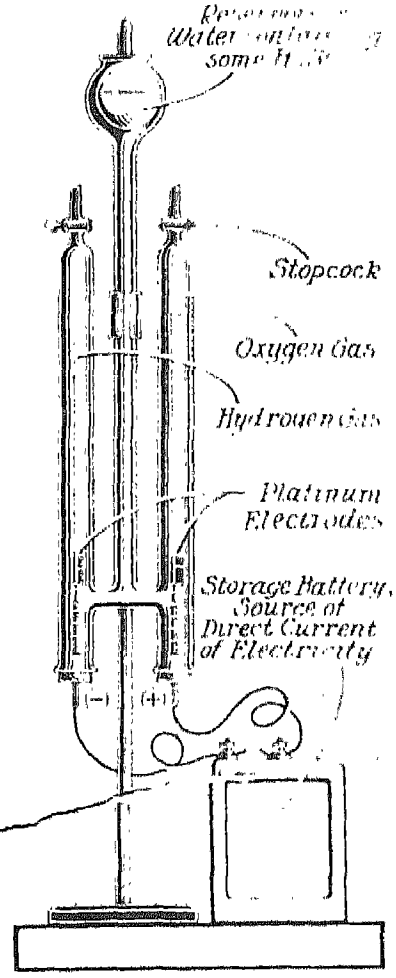
9. All living things are made up of elements, as are also all non-living things for that matter. What is meant by the word *element?* _____

_____

Your teacher will show you several elements that are needed for living matter and will demonstrate their properties or nature. Use the space below to record your observations.

Element	Characteristic nature or properties
1.	
2.	
3.	
4.	

10. Elements combine to form compounds that differ greatly in their properties. In order to see the remarkable difference between a compound and the elements of which it is composed, *analyze* (break down) water (H_2O) by the use of an electrolysis apparatus similar to the one shown in the drawing. Water, to which a little sulphuric acid (H_2SO_4) has been added, is placed in the apparatus and an electric current is sent through the water as indicated. You will notice that gas collects at the tops of the two tubes. You will further notice that there is twice as much gas in one tube as in the other. If you collect some of the gas of smaller quantity in a test tube and thrust a glowing splinter into the tube, you will probably find that the splinter glows much brighter or bursts into flame. This gas is oxygen. A burning match thrust into a test tube full of the gas of the greater quantity will probably cause a sharp report or explosion. This gas is hydrogen. Look carefully at the side of the test tube after the explosion and you probably will find drops of moisture. The hydrogen, in exploding, combined with oxygen to form water again.



IV. TESTING

1. Using your own words, write a definition for each of the following.

(1) Compound: _____

_____

(2) Organic matter: _____

_____

(3) Humus: _____

(4) Element: _____

_____

(5) Carbonic acid: _____

_____

Name _____ Date _____ Class _____

(6) Weathering: _____

_____

(7) Soil water _____

_____

(8) Minerals _____

_____

2. List the materials which make up a rich soil. _____

_____

_____

3. Outline the chief steps in the formation of soil. _____

_____

_____

_____

4. Why does soil containing much humus resist erosion more than soil containing little humus? _____

_____

_____

_____

5. You may hear it said that soil is our most important, most valuable, and most precious natural resource. Do you agree with this statement? Tell why, or why not. _____

_____

_____

_____

6. Would you expect to find that the soil formed more rapidly as more and more living plants and animals occupied the earth? _____ Why? _____

_____

_____

_____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State here any generalizations which from your study, observations, reading, and discussion you believe to be true regarding the formation and composition of the soil.

Name _____ Date _____ Class _____

Chapter 5: How Green Plants Obtain Food

Now that we know something about the formation and composition of the soil, we need to learn more about the relation of soil to life—to *all* life, human life as well as plant life. First we will think about the importance of soil to plant life.

I. DRAWING ON WHAT YOU ALREADY KNOW

These questions will be answered in your study of this chapter in BIOLOGY FOR BETTER LIVING. Perhaps you already know, or think you know, answers to some of them. Others will suggest ideas that you may never have thought of in connection with plant life. Write your best *present* answer to each. In Section V you will be given an opportunity to revise these answers.

1. Plants require water. Do you think of water as chiefly a plant food, a means of transporting food within the plant, or a "firming" agent? _____ Does water function, in connection with plants, in some ways not here mentioned?

   _____

2. Do you think of air as a "raw material" that plants need? _____

   Explain your answer. _____

   _____

3. Do all plants have leaves? _____ Could a plant that commonly bears leaves live without leaves? _____ Why do you think as you do? _____

   _____

   _____

4. Are plants able to live in complete darkness? _____ Tell why you think as you do.

   _____

5. Are plants able to live in a room which has no windows, but which is well lighted with electricity? _____ Tell why you think as you do. _____

   _____

   _____

6. List any other questions about plant food which you would like to have answered.

   _____

   _____

   _____

II. EXPLORING

Quinn, Vernon. *Leaves, Their Place in Life and Legend.* New York: Frederick A. Stokes Company, Inc., 1937. An unusually interesting discussion of curious leaves, edible leaves, poisonous leaves, and certain superstitions about them.

Brown, William H. *The Plant Kingdom.* Boston: Ginn and Company, 1935. For well presented information about how plants obtain food, see Chapters III and VII.

Peattie, Donald C. *The Flowering Earth.* New York: G. P. Putnam's Sons, 1939. This exciting book tells of the vital role of chlorophyll and protoplasm throughout the plant kingdom.

Carlson, A. J., and Johnson, Victor. *The Machinery of the Body.* Chicago: University of Chicago Press, 1941. The Cell—Its Significance and Structure, Chapter II, pp. 8–73.

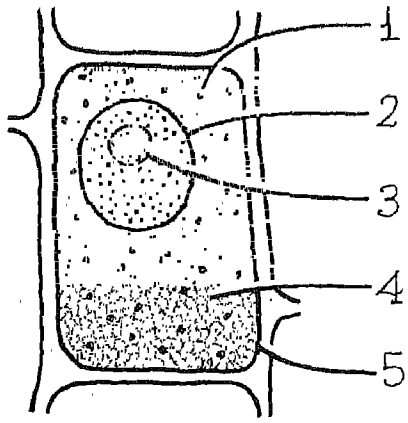
Barron, Leonard. *The Complete Book of Gardening.* New York: Doubleday, Doran & Company, 1936. Everything you want to know about gardening whether it be as a hobby or for necessity's sake.

Osterhout, W. J. V. *Experiments with Plants.* New York: The Macmillan Company, 1905. If you like to experiment with plants, you will find this book a useful guide. It suggests simple but effective experiments with stems, roots, and leaves.

III. DOING AND RECORDING

1. The unit of plant structure is the *cell.* Below is a diagram of a typical plant cell. Identify the parts and tell the function of each part.

Parts of plant cell	Function of each part
1. _____	1. _____
2. _____	_____
3. _____	_____
4. _____	2. _____
5. _____	_____
	_____
	3. _____
	_____
	_____
	4. _____
	_____
	_____
	5. _____
	_____
	_____



Name _____ Date _____ Class _____

2. Collect samples of cells from each of the sources listed below. Study each through a microscope. Then, in the space at the right, sketch the shapes of cells that you see.

(1) Cells from inside of mouth

(2) Cells from surface of a leaf

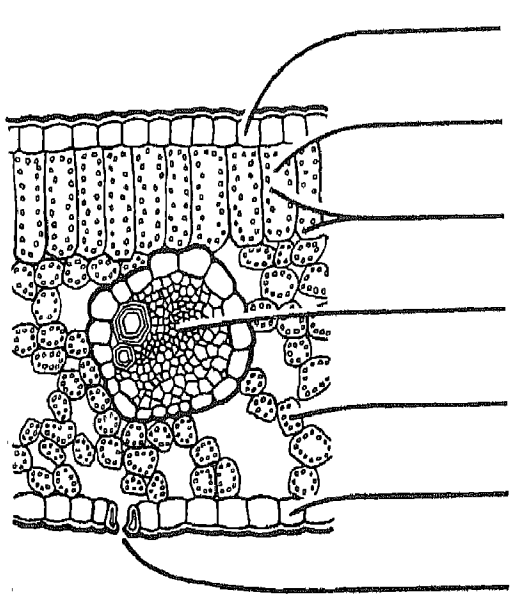
(3) Cells from onion membrane

3. Give a brief account of the "cell theory" as stated in turn by Schleiden and by Schwann.

Schleiden's theory: _____

Schwann's theory: _____

4. Study a cross section of a leaf under the microscope (low power). Then label the parts of the diagrammatic cross section below.



5. What is the function of each of the parts of a typical leaf listed below?

Leaf part	Function
Upper epidermis	
Palisade layer	
Spongy tissue	
Lower epidermis	
Stomata	
Guard cells	

6. You have learned that plants make various kinds of food materials carbohydrates, proteins, and fats. Before you perform tests to detect the presence of these food substances, you should learn how food tests are made. This exercise will help you do so.

   (1) *Test for starch:* Place a small pinch of corn starch or potato starch in a test tube with about ten cubic centimeters of water. Shake it well and heat to the boiling point. Add a few drops of iodine. What color reaction do you observe? _____

   Now do the same thing, using some grape sugar instead of the starch. Is there a reaction with grape sugar? _____

   Do the same thing, using some chopped boiled egg white. (Boiled egg white is mostly protein.) What happens? _____

   Is iodine a specific test for starch? _____

Name _____ Date _____ Class _____

(2) *Test for grape sugar:* Place a small amount of grape sugar in a Pyrex beaker with about twenty cubic centimeters of water. Then add a few drops of Fehling's Solution A and a few drops of Fehling's Solution B. Bring the contents slowly to a boil and observe the color change.

What happens when Fehling's Solution (mixture of A and B) is heated with a solution of grape sugar? _____

_____

Try starch instead of grape sugar. Does the same color change occur? _____
(If you use the same beaker, be sure to clean it out thoroughly)

Now try a piece of the boiled egg white instead of grape sugar with Fehling's Solutions A and B. What is the reaction? _____

_____

Does Fehling's Solution seem to be a specific test for grape sugar? _____

(3) *Test for protein:* Place a few small pieces of chipped boiled egg white in a test tube. Carefully add a few drops of nitric acid and observe the color change in the egg white. (Nitric acid is a very strong acid and must not be spilled on clothes or hands.) This is the specific test for proteins. Sometimes it is necessary to add ammonium hydroxide, in addition to nitric acid. What color change occurs?

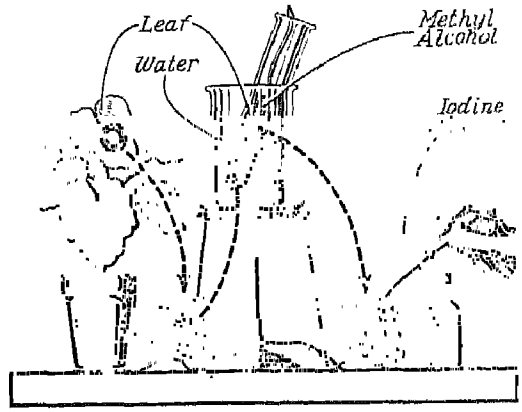
_____

(4) *Test for fat:* Place some butter or other greasy material on a piece of brown paper. Hold the paper up to the light. What appears? _____

7. Test each of the following substances for starch, sugar, protein, and fat. You will note that each of them is a product of green plants. Therefore, it should be clear that any food materials found were manufactured by the plant. You may need to prepare each one differently for the tests. For example, to test the potato for grape sugar, you will probably need to crush the potato and prepare a solution in water. To prepare the corn grains soak them and then cut them open.

Food	Starch	Grape sugar	Protein	Fat
Potato				
Walnut				
Raisin				
Apple (ripe)				
Apple (green)				
Corn grain				

8. Is light necessary for the manufacture of starch by green plants? In order to determine the answer to this question, perform the following experiment. Place a green plant such as a geranium or Coleus in the dark overnight. At the beginning of class, fasten a small piece of heavy black paper or tinfoil on both surfaces of a leaf. See drawing. Place the plant in the sunlight for two or three hours. Remove the leaf from the plant and, after removing the green chlorophyll by boiling the leaf in methyl alcohol, test it for the presence of starch. Caution: Alcohol is inflammable. Use a large wire gauze between the flame and the beaker. Place smaller beaker inside a water bath in larger beaker. See drawing.



To test for the presence of starch in the leaf, use a weak solution of iodine. What are the results? _____

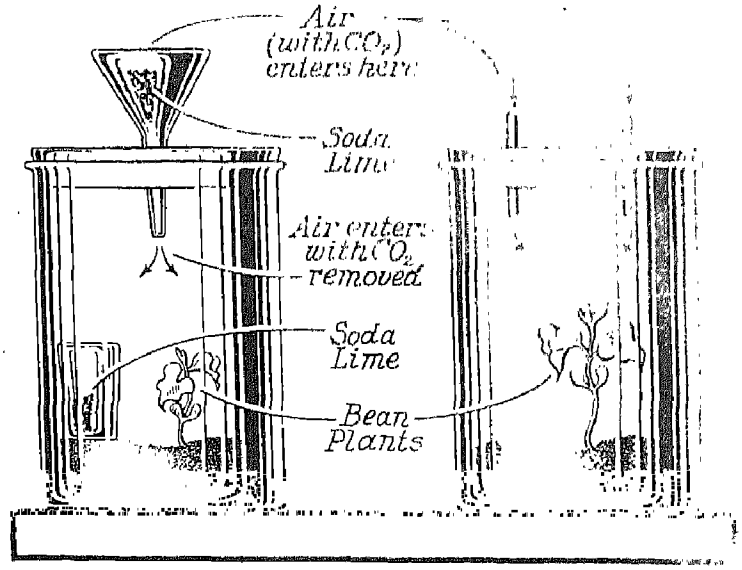
_____

What are your conclusions about the necessity of light for the manufacture of starch by green plants? _____

_____

_____

9. Is CO_2 necessary for the manufacture of starch? Set up an experiment as illustrated by the drawing below. Soda lime, which is placed in the funnel and in a small jar in one of the large jars, absorbs and removes carbon dioxide from the air.



Remove a leaf from each of the two plants and test for starch.

What were your results? _____

_____

Name _____ Date _____ Class _____

What are your conclusions? _____

_____

Continue the experiment as set up for a week or two. What happens? _____

Why? _____

_____

10. What are the waste products given off in photosynthesis? Where do these waste products come from? _____

_____

_____

_____

IV. TESTING

1. Encircle the letter in front of all endings which correctly complete each of the four unfinished statements. You may find more than one correct ending in each group.

(1) Photosynthesis is a process which
- (a) requires light.
- (b) takes place best during darkness.
- (c) makes use of carbon dioxide.
- (d) releases nitrogen and carbon dioxide.
- (e) forms food in green leaves.

(2) The leaves of all green plants contain
- (a) more stomata in the upper surface than in the lower surface.
- (b) palisade cells which help manufacture food.
- (c) iodine which tests for the presence of starch.
- (d) spongy tissue which primarily absorbs light.
- (e) outside openings through which most of the water enters the leaf.

(3) A green plant
- (a) gives off oxygen while in the presence of sunlight.
- (b) can make simple sugars.
- (c) is known as a fungus.
- (d) will grow best without oxygen.
- (e) can make proteins by a process of photosynthesis.

(4) Chlorophyll is
- (a) found primarily in the stomata.
- (b) necessary for the formation of proteins.
- (c) green pigment material inside the chloroplast cells.
- (d) necessary for photosynthesis.
- (e) located mostly in the palisade layer of cells of the leaf.

2. The equations below are the chemical equations for photosynthesis and for respiration in plants. Write "photosynthesis" after the equation which represents that process.

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$ _____

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_2O + 6\ CO_2$ _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which, from your study, observations, reading, and discussion, you believe to be true regarding the food-getting habits of green plants.

Name _____ Date _____ Class _____

Chapter 6: Plant Roots and the Soil

Light and air are necessary in the *manufacture* of plant food; soil, in most cases, is a necessary *source* of plant food. The following exercises will help you to understand the relation of roots to the manufacture of plant food and to other critical plant processes.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions, write your best *present* answer. Your most intelligent guess may be the best you can do in answering some of them. In Section V you will have an opportunity to revise these answers.

1. What functions do the roots of plants serve? _____

2. Root systems of different plants differ greatly in size, shape, and extent. Why, do you think, is this so? _____

3. Suggest factors which you think might influence the *direction* in which roots grow and the *depth* to which they grow. _____

4. Suggest ways in which roots might benefit the soil, either by making it richer or otherwise bettering it for the continued growth of plants. _____

5. How do roots aid in preventing soil erosion? _____

6. What other questions or problems concerned with plant roots and the soil would you like to have answered?

II. EXPLORING

Quinn, Vernon. *Roots, Their Place in Life and Legend.* New York: Frederick A. Stokes Company, Inc., 1936. The many uses of roots for foods, drugs and for poisons are interestingly discussed.

Brown, William H. *The Plant Kingdom.* Boston: Ginn and Company, 1935. A good statement of the relation of roots to the soil is found in Chapter XI.

Hottes, Alfred C. *The Book of Annuals.* Third Edition. New York: Dodd, Mead & Company, 1935. The flowering annuals of merit—where and how to plant them.

Hottes, Alfred C. *The Book of Perennials.* New York: Dodd, Mead & Company, 1931. Excellent for the gardener. It gives lists of 25 tallest plants, 25 perennials for July bloom, etc.

Verrill, Alpheus, H. *Wonder Plants and Plant Wonders.* New York: D. Appleton-Century Company, Inc., 1939. A fascinating and amusing book, packed with curious lore about plants.

Connors, Charles Henry, and Tiedjens, Victor A. *Chemical Gardening for the Amateur.* New York: William H. Wise and Company, 1939. Written for anyone who wishes to grow plants—in his home, sun porch, or garden corner—by use of chemical solutions.

III. DOING AND RECORDING

1. Examine the roots of several plants and note or draw their general type of structure (fibrous, tap, aerial, fleshy, brace, etc.). Then indicate the functions of each (absorbs water, dissolves minerals, stores food, etc.). Use spaces at the top of page 37 for recording similar observations in connection with two roots of your own choice.

Plant	Type of root	Functions
Carrot		
Onion		
Grass		

Name _____ Date _____ Class _____

2. Germinate radish, mustard, or some other seeds in a Petri dish or on damp blotters. Examine the root hairs on some of the roots under a microscope. Sketch a root hair and label its parts.

Drawing of root hair

Names of parts

_____

_____

_____

3. Germinate several bean seeds in moist sand or sawdust. What do you observe about the roots as they develop? _____

_____

_____

Sketch a root that has developed a primary root; one that has developed a secondary root; and one that has developed a tertiary root.

Primary root

Secondary root

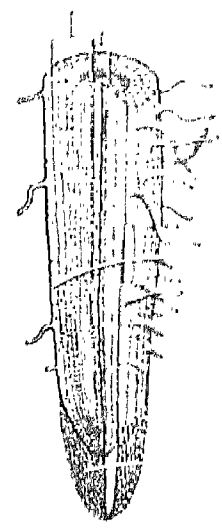
Tertiary root

4. Devise experiments to determine whether moisture attracts, repels, or has no effect on the growth of roots. Devise experiments to determine the same for light, and the same for gravity. Record observations in table.

Root used	Procedure	Result
	To show effect of moisture	
	To show effect of light	
	To show effect of gravity	

5. On the blanks at the left, write the names of the root parts labeled on the diagram.

1. _____
2. _____
3. _____
4. _____
5. _____



6. To demonstrate diffusion: Have someone at the front of the room pour a small amount of ether or carbon bisulfide into a shallow vessel. Direct each member of the class to raise his hand as soon as the odor of the liquid reaches him. What is diffusion?

_____

_____

7. By referring to the diagram and text on pages 105 and 106 of BIOLOGY FOR BETTER LIVING, set up an experiment to demonstrate osmosis. What is osmosis?

_____

_____

Name _____ Date _____ Class _____

8. Secure two stalks of celery. Place one in a jar of clear water and another in a jar containing a saturated solution of salt. Leave until the next day. What has happened?

_____

How does the preceding experiment help one to understand the danger of taking saline (salt) laxatives? How would such laxatives act in the intestines on the walls of the intestines? _____

_____

9. What are annual plants? _____

What are biennial plants? _____

What are perennial plants? _____

10. Make a list of several plants belonging to each of the above classifications. Note what kind of root each plant has. See if you have enough evidence on the basis of your observations to warrant making tentative generalizations about types of roots possessed by each class of plants.

Annuals: _____, _____, _____, _____

Generalization: _____

_____

Biennials: _____, _____, _____, _____

Generalization: _____

_____

Perennials: _____, _____, _____, _____

Generalization: _____

_____

11. Into each of two test tubes pour some slightly alkaline solution. To each add a little phenolphthalein. In one tube only, place one or two bean seedlings. Keep the two tubes for observation during the day. What do you observe? _____

_____

Conclusion: _____

_____

Place some dilute hydrochloric acid on limestone. What happens? _____

From the foregoing observations, what might you conclude about the action of roots on rock particles in the soil? _____

_____

_____

12. A *hydroponics* experiment to determine the best combination of minerals for the growth of some common plant, such as impatiens, corn, or bean seedlings. Several individuals of the plant chosen should be used and their growth observed as it takes place in a *normal solution* and in *each test solution*. Wash the plants clean and use only clean jars or containers. These should be covered with black paper so the roots will not be too much exposed to the light. Make wire frames to hold the plants upright in the containers. Roots need air, so suspend them above the water occasionally for an hour or so. The *normal solution*, or control solution in this case, can be made as follows:

Distilled water	1 liter	K_2SO_4	0.25 gm.
$Ca(NO_3)_2 \cdot 4H_2O$	1 gm.	$FeCl_3$	trace
KH_2PO_4	0.25 gm.		
$Mg(H_2PO_4)_2$	0.25 gm.		

Test Solutions	Resulting Growth (Describe change in size and general vigor of plant)
(1) Distilled water: _____	
(2) Normal solution minus magnesium biphosphate: _____	
(3) Solution made by substituting calcium chloride for calcium nitrate in normal solution: _____	
(4) Solution made by substituting potassium nitrate for calcium nitrate: _____	
(5) Solution made by substituting magnesium sulfate for magnesium biphosphate and potassium nitrate for potassium phosphate: _____	
(6) Solution made by substituting iron phosphate for iron chloride: _____	
(7) Solution made by substituting potassium chloride for iron chloride: _____	
(8) Solution made by substituting iron phosphate for potassium phosphate and calcium sulfate for potassium sulfate: _____	

Name _____ Date _____ Class _____

IV. TESTING

1. Place in the parentheses before each of the five terms listed below the word or group of words that most nearly defines that term.

( ) Osmosis
absorption; diffusion; capillarity; root hair

( ) Vacuole
cell membrane; root cap; storage space in cell; nitrogen

( ) Epidermis
cell sap; outer layer; root hairs; cortex

( ) Root tubercle bacteria
nitrogen-fixing bacteria; oxygen-fixing bacteria; membrane of cell; nodule

( ) Phenolphthalein
root system; an indicator; a colored liquid; a kind of medicine

2. Encircle the ending which *best* completes each of the five unfinished statements.

(1) During the process of osmosis, the
diffusing membrane must be of rubber.
inner cell must be filled with sugar solution.
chlorophyll in the leaves becomes inactive.
liquid in which water is most concentrated passes to the place where the water is less concentrated.

(2) Liquids pass up the roots through the
central cylinder.
cortex.
vacuoles.
epidermis.

(3) A root hair is useful because it
is a single-celled structure.
provides a surface which readily absorbs water.
is strong and can push away obstacles.
can transform free nitrogen to a form usable by plants.

(4) There is a large quantity of nitrogen in the air in the form of
free nitrogen.
ammonia.
nitrates.
nitrites.

(5) Bacteria which live in the nodules of legumes can convert
free nitrogen into complex nitrogenous compounds.
nitrites into nitrogen.
nitrates into ammonia.
ammonia into nodules.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which from your study, observations, reading, and discussions you believe to be true regarding plant roots and the soil.

Name _____ Date _____ Class _____

Chapter 7: Plant Stems and the Transportation of Foods and Raw Materials

The title of this chapter suggests a function of another part of the plant system. Much of what you now know about roots will help you in understanding the structure and purpose of plant stems. Most plants have stems, but some stems are modified in ways which make them differ greatly in appearance from those we are accustomed to see.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each question write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Why do plants sometimes die when their stems are injured? _____

2. Suggest why it is necessary for some tall plants to be supported or braced. _____

3. What is meant by girdling a tree? _____ What usually is the purpose of girdling? _____

4. Suggest as many functions of the stem as you now can. _____ Did you include reproduction? _____ Why? _____

5. List any other questions about plant stems that you wish to have answered.

II. EXPLORING

Brown, William H. *The Plant Kingdom.* Boston: Ginn and Company, 1935. The stem and its functions, Chapters VIII, IX, X.

Collingwood, G. H. *Knowing Your Trees.* Washington: The American Forestry Association, 1941. Gives pictures of more than fifty trees—of their stems and leaves.

Ditmars, Raymond L. *The Forest Adventure.* New York: The Macmillan Company, 1933. An exciting narrative of travels in the South American tropics.

Ries, U. H. *Pruning and Repairing of Trees, Shrubs, and Ornamentals.* New York: Doubleday, Doran and Company, 1936.

Elliott, Charles N. *Careers in Forestry.* Chicago: Science Research Associates, 1941. This booklet gives a summary of the many branches of forestry which offer careers, and explains the work involved in each branch.

Fairchild, David. *The World Was My Garden.* New York: Charles Scribner's Sons, 1938. The famous botanist's exciting story of his travels while exploring for plants in all parts of the world.

Osterhout, W. J. V. *Experiments with Plants.* New York: The Macmillan Company, 1905.

III. DOING AND RECORDING

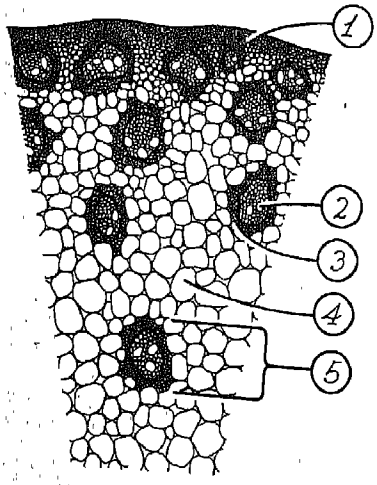
1. Place the tip of a celery, willow, or corn stem in red ink or eosin. Examine it next day. Cut a cross section and a longitudinal one from the stem and examine them carefully. What do you observe? _____

_____

_____

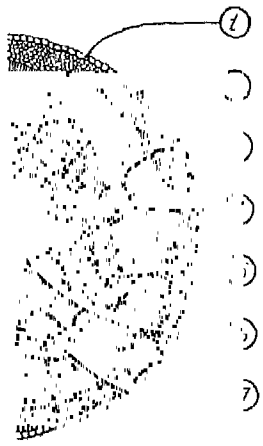
Observe a cross section of one of the stems under a microscope and, in the space at the left, make a sketch to show where the colored liquids are. Label as many parts of the stem as you can identify.

2. Below is a cross section drawing of a corn stem (monocotyledon). At the top of the next page is a cross section drawing of a birthwort stem, commonly called Aristolochia (dicotyledon). Identify the parts shown in each drawing and give the function of each part.



Parts of monocot stem	Function
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Name _____ Date _____ Class _____



	Parts of dicot stem	Function
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____

3. Explain briefly how growth occurs—

(1) Lengthwise, in a dicotyledonous stem: _____

_____

_____

(2) Crosswise, in a dicotyledonous stem: _____

_____

_____

(3) Lengthwise, in a monocotyledonous stem: _____

_____

_____

(4) Crosswise, in a monocotyledonous stem: _____

_____

_____

4. Place a freshly cut willow stem in water. After roots have developed, girdle the stem just above where the roots have developed. Allow the stem to stand in water above the girdled region for several days. What happens? _____

_____

_____

_____

What does the foregoing experiment show about the flow of food materials in the stem?

5. What is an accurate explanation of the cause of the death of a tree after it has been girdled?

6. Name five functions served by various kinds of stems.

Function	Kind of stem

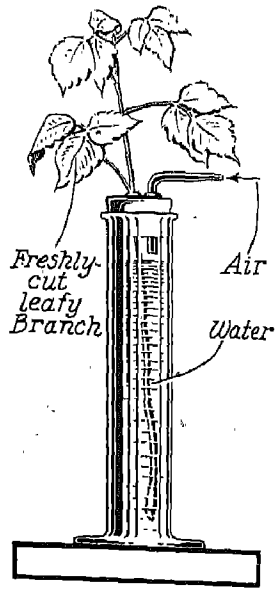
7. What forces play a part in helping liquids rise in stems?

8. Prepare reports on the commercial uses made of stems, of products of stems, and of saps.

9. What plants with modified stems can be found in your locality?

10. If possible, examine a cross section of a tree, cut in your locality, and determine its approximate age.

11. To determine the loss of water by a plant over a given time:



Fill a 100 cc graduated cylinder about ¾ full of water. Fit the mouth with a two hole rubber stopper. Slit one side of the stopper to insert the stem of a freshly-cut leafy branch. The stem should not quite reach the bottom of the cylinder. Do not crush the stem. Into the other hole insert a glass tube drawn to a jet to admit air. Very little evaporation will result. Seal all the joints with grease. What are your observations after several hours?

Name _____ Date _____ Class _____

(1) Set the plant in a sunny window in a warm room.

Level of water at beginning _____

Level of water after 3 hours _____

What is the difference in level of water? _____

What is the explanation of this difference? _____

_____

(2) Place the plant in a shady, cool place for 3 hours.

What is the amount of water lost? _____

(3) Place the plant with the leaves exposed to the breeze of an electric fan for 3 hours

What is the amount of water lost? _____

IV. TESTING

1. In the following exercises underline the two words which represent most closely the same kind of structure or function. Example: eye foot head ear knee

(1)	stomata	taproot	sap	xylem	lenticels
(2)	dicot stem	cambium	bark	cortex	monocot stem
(3)	epidermis	chlorophyll	pith	phloem	xylem
(4)	medullary rays	annual ring	cortex	cambium layer	pith rays
(5)	old cambium cells	annual ring	bark	old xylem cells	old phloem cells

2. Give brief explanations to the following questions:

(1) What function do the older and nonconducting xylem tubes serve? _____

_____

(2) How is the grain formed in the tops of wooden desks or other furniture? _____

_____

(3) How are the knotholes in lumber formed? _____

_____

(4) If the cambium produces both phloem and xylem cells, why does the bark of a tree not become as thick as the woody cylinder? _____

_____

3. Sketch a diagrammatic scheme of an entire plant to show the direction of flow of materials within the plant. Label parts and indicate what happens in each.

Parts of plant	What happens in each part
(1)	
(2)	
(3)	
(4)	
(5)	
(6)	

V. SUMMARIZING

1. Reread your answers to the question in Sections I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which you now believe to be true regarding plant stems and the transportation of food and raw materials in plants.

Name _____ Date _____ Class _____

Chapter 8: To Save Our Land

You share with others the responsibility for solving problems concerned with good land use in your own community. That responsibility involves viewing your local community in relation to wider state, national, and international communities. The following questions will help you to see what some of these problems are. Keep them in mind as you study this chapter in BIOLOGY FOR BETTER LIVING.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. The national land policy of the United States has always been that of trying to get all public domain into private ownership. Only about 400 million acres of marginal lands now comprise our public domain. Each year thousands of applications are made for homesteads in parts of this domain—all with little or no chance of successful agricultural use. Suggest some of the problems growing out of this situation.

2. What are some of the requirements for permanent successful agricultural land use?

3. Are farm owners and tenants in your locality compelled by law to apply land control measures? _____ What problems does this situation give rise to? _____

4. How do you account for so many farm owners being *absentee* owners? _____

   What problems grow out of this situation? _____

5. What good soil conservation practices can you now name? _____

_____

_____

6. What problems of good land use have grown, in part, out of the vast mechanization of agriculture? _____

_____

_____

7. What further questions concerned with good land use in your own locality would you like to have answered? _____

_____

_____

II. EXPLORING

Bennett, Hugh H. *Soil Conservation.* New York: McGraw-Hill Book Company, 1939. Part II of this book includes a thorough presentation of all the modern techniques of soil-erosion control with specific reference to various regions of the United States.

Sears, Paul B. *Life and Environment.* New York: Bureau of Publications, Teachers College, Columbia University, 1939. A discussion of the interrelationships between plant and animal communities.

U.S.D.A. Yearbook, 1938. *Soils and Men.* (a) "America's Traditional Land Policy," pp. 111–136. (b) "The Remedies" (for our soil problems), pp. 198–295. (c) "Crop Rotation," pp. 406–430. (d) "The Use of Cover and Green-manure Crops," pp. 431–444. (e) "Strip Cropping," pp. 634–645.

U.S.D.A. Yearbook, 1940. *Farmers in a Changing World.* Washington: U. S. Government Printing Office.

U.S.D.A. Farmers' Bulletins: No. 1767—*Soil Defense in the Piedmont.* No. 1771—*Preventing Soil Blowing on the Southern Great Plains.* No. 1773—*Soil and Water Conservation in the Pacific Northwest.* No. 1795—*Conserving Corn Belt Soil.* No. 1809—*Soil Defense in the South.* No. 1810—*Soil Defense in the Northeast.* No. 1813—*Prevention and Control of Gullies.* These bulletins discuss the problems of soil erosion, and suggest appropriate methods for dealing with soil losses in the regions indicated by the titles of the bulletins.

U.S.D.A. Miscellaneous Publication, No. 321. *To Hold This Soil.* This is a stirring account of the tragedy of our national soil losses over a few generations with excellent discussion of positive control measures.

National Resources Planning Board. *National Resources Board Report.* 1939. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. ($3.25). A report on national planning and public works in relation to natural resources, including land use, and water and mineral resources.

The American Guide Series. Write to your State Administrator, Works Progress Administration, for price and publisher of your state guide, if not available in your school or public library.

U.S.D.A. Miscellaneous Publication, No. 293. *Soil Conservation Districts for Erosion Control,* October, 1937, 19 pp., 10¢. This describes the procedures for setting up a local soil conservation district.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. The Soil Conservation Service was created by Congress in 1935. Use appropriate references to learn some of the specific functions of this service. List some of them here.

_____

_____

_____

_____

2. Has your state provided for establishing soil conservation districts? (See *Soil Conservation Districts for Erosion Control*, U.S.D.A., Misc. Publication No. 293.) What opportunities are provided for farmers under this organization? _____

_____

_____

_____

_____

3. What are some of the agencies, organized groups, or special societies in your community that are at present interested in conservation programs, or through which you believe worthwhile work could be done?

Agency	Work which agency is doing, or might do

4. What proposals or actions relating to good land use have been mentioned recently in your local newspapers? In a sentence or two, describe the proposals and give source.

_____

_____

_____

5. Among many practices employed in programs of good land use are the ones listed below. After sufficient reading, observation, and discussion, summarize the information called for in the following table.

Good land use measure or practice	What information have you found about the usefulness of each method in your community or region?
Terracing	
Contour farming	
Crop rotation	
Strip cropping	
Stabilizing gullies	
Summer fallowing	

6. List six legume plants that are useful in helping to build up nitrogen reserves in the soil. Underline those that are grown in your state.

(1) _____ (4) _____

(2) _____ (5) _____

(3) _____ (6) _____

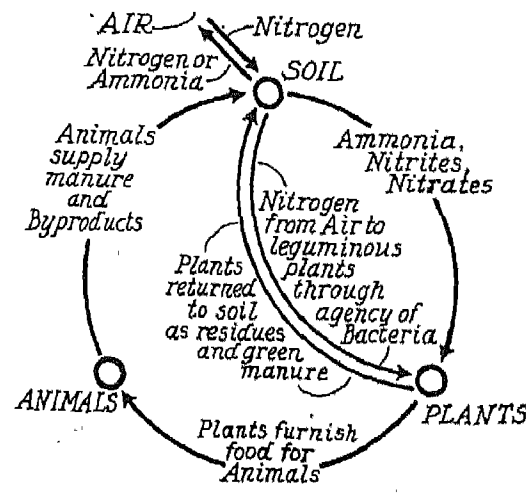
7. The diagram opposite shows the nitrogen cycle. After studying your text and other references, explain the diagram in your own words. Where do legumes fit into this cycle? _____

_____

_____

_____

_____



Name _____ Date _____ Class _____

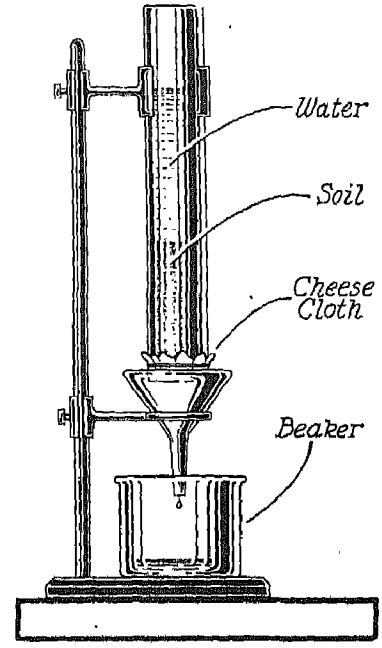
8. Prepare a rain gauge and keep an accurate record of the rainfall in your community for one month. Use a No. 3 tin can, cut smooth at the top and mounted on a post or other support that is out in the open away from trees or eaves of buildings. Measure rainfall after each rainstorm. Keep individual records and compare measurements.

1st rain _____ inches	4th rain _____ inches	7th rain _____ inches
2nd rain _____ inches	5th rain _____ inches	8th rain _____ inches
3rd rain _____ inches	6th rain _____ inches	9th rain _____ inches

_____ Total rainfall for month

9. Arrange with your local soil conservation office or county agricultural agent to visit soil conservation projects. Attach to this page a description of methods observed.

10. To show relation of soil quality to its capacity for filtering and absorbing water, collect as many different kinds of soil as are available. Place them in open pans in the same room for several days to let each soil sample acquire the same moisture content. Using a glass tube (diameter about 2″), set up an apparatus like the one pictured here. Place soil in the glass tube and pour water on it. Use the same amount of water and soil in each trial. Determine the time it takes for the water to run through each sample of soil. Measure also the amount of water which comes through in each case. Record your results in the following table.



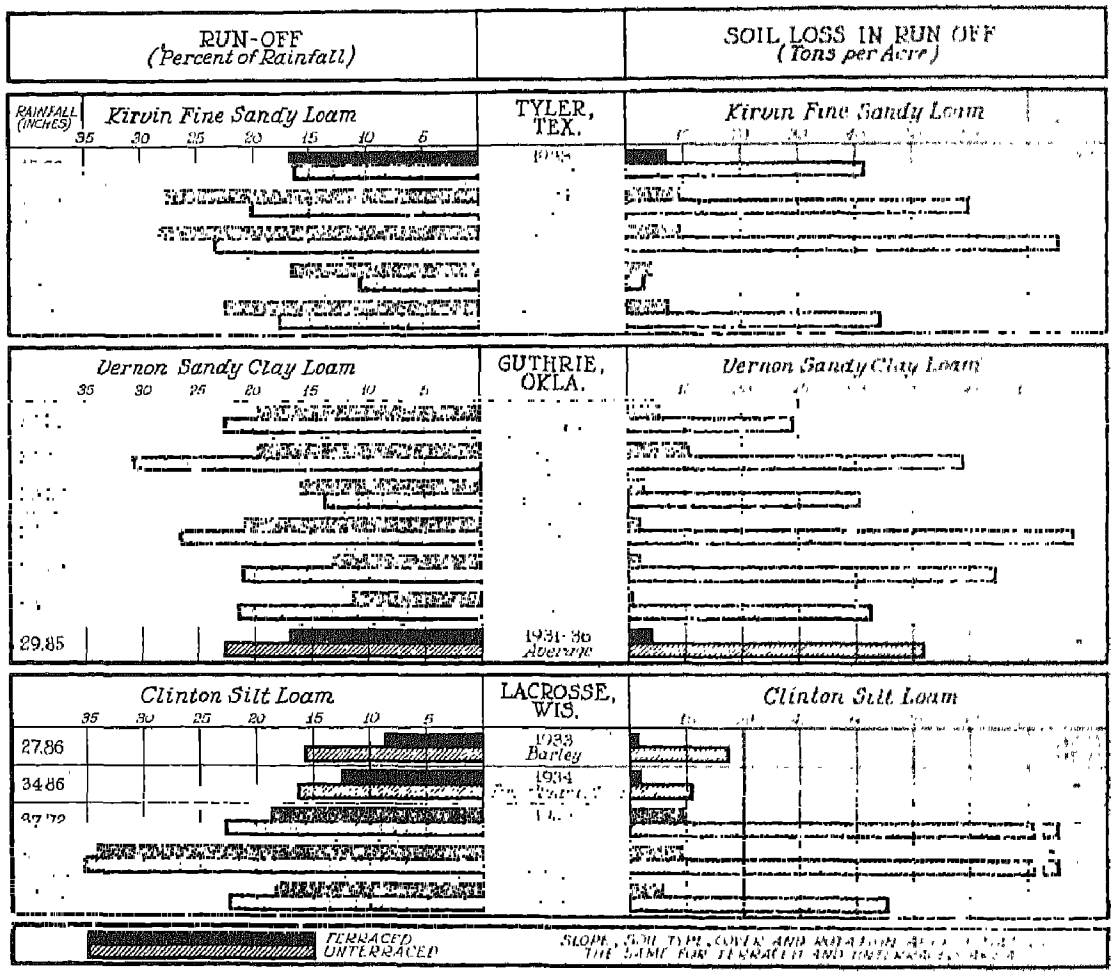
Soil sample	Amount of water used	Time used in filtering and soaking	Amount of water in beaker

State conclusions about the quality of soil in relation to filtering and absorbing ability.

_____

IV. TESTING

1. The following exercises will test your ability to read and interpret data from graphs. Run-off and soil loss in run-off from field plots at three soil and water conservation experiment stations are shown below. The terraces were supported by crop rotations and contour tillage, which were also used on the unterraced areas. Note that the water run-off is generally rather high, particularly on the Kirvin Fine Sandy Loam plot. When *level* terraces are used with closed ends, practically none of the rainfall is lost through surface run-off. The higher soil losses reported for the terraced areas at Guthrie during 1931–32 resulted from inadequate outlet protection.



(1) Place the number of the most nearly correct ending in the parentheses before each unfinished statement. You will find the correct answers by carefully studying the preceding graph.

( ) The highest average rainfall for the years considered was reported at *1.* Tyler *2.* Guthrie *3.* LaCrosse

( ) In 1934 the experimental plot showing the greatest soil loss was planted to *1.* corn *2.* timothy *3.* cowpeas *4.* cotton *5.* barley

( ) The per cent slope of the Tyler plot was approximately *1.* 27–31 *2.* 10 *3.* 12 *4.* 7.5 *5.* 3.4

( ) The per cent run-off was greater in 1935 on the terraced than on the unterraced plots at *1.* LaCrosse *2.* Guthrie *3.* Tyler *4.* no place

( ) The tons per acre soil loss by run-off in 1934 on the unterraced land at LaCrosse was about *1.* 15 *2.* 17 *3.* 4 *4.* 105 *5.*

Name _____ Date _____ Class _____

(2) Assuming that the data given above are correct, mark each of the following statements with the letter *a* if the evidence is sufficient to make the statement *true;* with the letter *b* if the evidence suggests that the statement is *probably true;* with the letter *c* if the evidence is *insufficient* to make a decision concerning the statement; with the letter *d* if the evidence suggests that the statement is *probably false;* and with the letter *e* if the evidence is sufficient to make the statement *certainly false*

( ) Terraced land has less soil loss per acre than unterraced land.

( ) At Guthrie the soil loss on unterraced land planted to cowpeas increased with the increase in rainfall.

( ) Timothy and clover are better soil-retaining crops than barley.

( ) The government should require all farmers to terrace their land.

( ) Where the per cent of run-off is greater on terraced than on unterraced land, there is a greater soil loss on the terraced land.

( ) In terracing, amount of soil loss is the most important factor to consider.

( ) In general, the greater the run-off the greater the soil loss.

( ) The average soil loss in run-off on terraced land was greatest where the average rainfall was greatest.

( ) Soil loss is greater on corn land if corn follows cowpeas than it is if corn follows timothy and clover.

( ) The lowest rainfall in any year reported was approximately twenty-one inches.

( ) The small soil loss on terraced land in 1936 was the result of the small rainfall.

( ) Vernon sandy clay loam is better land than Kirvin fine sandy loam or Clinton silt loam.

( ) More tons of soil per acre were lost from land planted to cowpeas at Tyler in 1935 than from land so planted at Guthrie during the same year.

( ) It is best always to plant land to timothy and clover.

( ) The greater the slope of the land, the greater the need for terracing the land.

( ) Terracing is more effective in reducing soil loss in sandy clay loam than in silt loam or fine sandy loam.

2. Definite agreement or disagreement can be obtained from soil experts on the following items. Place the letter *A* before each statement to which you think experts would agree. Place *D* before those about which you think experts would disagree.

( ) Contour farming is always the best method of preventing erosion on farm land.

( ) Wheat is usually rotated with corn for best conservation of moisture.

( ) Less water run-off would be expected from a field continuously planted to grass than from one of equal size continuously planted to corn.

( ) In general, soil loss increases with greater water run-off.

( ) Soil erosion has occurred in America during only the last fifty years.

( ) Formation of gullies is the most serious form of erosion.

( ) Every state in the union has passed a law that permits its citizens to take advantage of the federal government's program of soil conservation.

( ) For farmers to burn the wheat stubble after harvest is bad for the land.

( ) Every farm has its own natural drainage which should be taken into account in soil conservation planning.

( ) Conservation means not using our resources because they are getting scarce.

( ) Since plants can now be grown without soil, there is no longer any need to be concerned with soil conservation.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. What generalizations concerned with the conservation of our land can you now state on the basis of your recent study, observations, reading, and discussions?

Name _____ Date _____ Class _____

UNIT II. HOW ARE LIVING THINGS ADAPTED FOR THE LIVES THEY LEAD?

Chapter 9: Classifying and Naming Living Things

Since the land, the water, and the air teem with living things, cooperative efforts of men of science in all parts of the world are needed for their study. These cooperative efforts would be impossible unless there were some way of grouping living things according to recognizable common characteristics. The exercises in this chapter will help you better to see the convenience and importance of grouping, classifying, and naming living things.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. What problems might arise among scientists if two or more different kinds of living things (disease germs, for example) were to have the same name? _____

_____

_____

2. Perhaps you have made or have seen a collection of butterflies. At any rate, you know there are many kinds of butterflies and that they are found in all parts of the world. What difficulties might arise if these insects were all given only the common name "butterfly"? _____

_____

_____

3. Make a list of 24 animals that you can recognize and name. Then work out a scheme by which you could classify them into several distinct groups. You may wish to classify them according to size, color, food, the way they move, or some combination of these characteristics. Be critical of the difficulties that arise as you classify these animals. After you have studied more about classification, you may wish to re-do this exercise. You will be given that opportunity in Section V.

1. _____	7. _____	13. _____	19. _____
2. _____	8. _____	14. _____	20. _____
3. _____	9. _____	15. _____	21. _____
4. _____	10. _____	16. _____	22. _____
5. _____	11. _____	17. _____	23. _____
6. _____	12. _____	18. _____	24. _____

Scheme of classification: _____

_____

Classification of Animals

Group I	Group II	Group III	Group IV	Group V

4. What is the advantage of your having a first name as well as a last name?

_____

5. The housecat has the scientific name of "Felis domestica." All living things that have been classified have two names, a *generic* and a *specific* name. Suggest why a single name is not sufficient. _____

_____

6. What questions concerning the classification of living things would you like to have answered?

_____

_____

II. EXPLORING

Hegner, Robert. *Parade of the Animal Kingdom*. New York: The Macmillan Company, 1935. A picture book of typical animals.

Parker, Bertha Morris. *Trees*. Evanston, Illinois: Row, Peterson and Company, 1941. A 36-page pamphlet that is well illustrated and extremely interesting.

Romer, Alfred S. *Man and the Vertebrates*. Chicago: University of Chicago Press, 1939. To find descriptions of many of the higher animals, see Chapters I–XI.

Buchsbaum, Ralph. *Animals Without Backbones*. Chicago: The University of Chicago Press, 1938. An illustrated and highly interesting account.

Daglish, Eric F. *How to See Beasts*. New York: William Morrow and Company, 1933. A simply written account of the various types of beasts—gnawing, hoofed, flesh-eating, flying, etc.

Fernald, H. T. *Applied Entomology*. New York: McGraw-Hill Book Company, Inc., 1935. A useful text which classifies and describes all the important insects.

Singer, Charles. *Story of Living Things*. New York: Harper & Brothers, 1931. Chapter V helps you to understand classification systems, and why the men who first used them began using them.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. What physical characteristics are common to each of the following pairs?

   (1) Bird and snake _____

   (2) Snake and cat _____

   (3) Fish and dog _____

   (4) Earthworm and snake _____

2. Since there are common characteristics between so many animals, how is it possible to classify all members of the animal kingdom? _____

   _____

   _____

3. List a few examples of plants which are included in the groups given below.

   (1) Thallus plants (Thallophytes) _____

   (2) Moss plants (Bryophytes) _____

   (3) Ferns (Pteridophytes) _____

   (4) Seed bearing plants (Spermatophytes) _____

      (a) Gymnosperms _____

      (b) Angiosperms _____

4. Use a textbook, key, or manual of classification to get a complete classification of the plant and the animal suggested below, or of one each of your own choosing.

	Common name—dandelion	Common name—housefly
Kingdom	_____	_____
Phylum	_____	_____
Class	_____	_____
Order	_____	_____
Family	_____	_____
Genus	_____	_____
Species	_____	_____

5. Using a biology text or zoology book, find an example of an animal in each of the following groups. Then summarize briefly the common characteristics which describe animals in each group.

Animal group	Example	Brief description
One celled (Protozoa)		
Sponges (Porifera)		
The Cup Animals (Coelenterates)		
Spiny skinned (Echinoderms)		
Soft Bodied Animals (Mollusks)		
Flatworms		
Roundworms		
Segmented worms		
Arthropods		
(a) Insects		
(b) Crustaceans		
(c) Millipedes		
(d) Arachnids		
Vertebrates		
(a) Fish		
(b) Reptiles		
(c) Birds		
(d) Amphibians		
(e) Mammals		

IV. TESTING

These exercises will guide you in taking descriptions of animals and in locating their classification. Use your text and other references to help you in finding the answers.

1. The first line of each of the following gives two or three significant characteristics of an organism or group of organisms. Select the group or class which is described by those characteristics, and place its letter on the blank in front of the line.

____ (1) Single-celled, possess no chlorophyll, have definite powers of locomotion.

(a) Protozoa (b) Porifera
(c) Fungi (d) Thallophyta

Name _____ Date _____ Class _____

____ (2) Hollow stomach, tentacles, many celled, radially symmetrical.
(a) Hydra (b) Sponge
(c) Bacteria (d) Cat

____ (3) Unsegmented body, muscular foot, outer shell.
(a) Insect (b) Turtle
(c) Mollusk (d) Spider

____ (4) Radial symmetry, tube feet, spiny skin.
(a) Porcupine (b) Starfish
(c) Bee (d) Oyster

____ (5) Backbone, scales, cold blooded.
(a) Aves (b) Amphibia
(c) Reptilia (d) Mammalia

____ (6) Backbone, scales, cold blooded, no external appendages
(a) Snake (b) Turtle
(c) Crocodile (d) Alligator

____ (7) Jointed appendages, exoskeleton, segmented body.
(a) Mammals (b) Arthropods
(c) Vertebrates (d) Porifera

____ (8) Exoskeleton, six legs, three body regions.
(a) Spider (b) Crayfish
(c) Insect (d) Clam

____ (9) Jointed appendages, eight legs, no true jaws, exoskelcton of chitin.
(a) Ant (b) Butterfly
(c) Crayfish (d) Spider

____ (10) Notochord, milk glands, 4-chambered heart, hair.
(a) Turtle (b) Fish
(c) Mammal (d) Dinosaur

____ (11) Covered with hair, gnawing teeth, milk glands, backbone.
(a) Chiroptera (b) Primates
(c) Whales (d) Rodents

2. Encircle the name of the organism in each of the following ten groups which does not belong with the other three because it does not have a certain characteristic common to those three.

(1) frog	salamander	snake	toad
(2) lizard	crocodile	salamander	alligator
(3) rodents	primates	carnivores	amphibians
(4) salmon	whale	carp	catfish
(5) bee	ant	spider	wasp
(6) Porifera	Vertebrata	Mollusca	Echinodermata
(7) Protozoa	Porifera	Arthropoda	Annelida
(8) worms	fishes	birds	amphibians
(9) amoeba	sponge	paramecium	Stentor
(10) cat	lion	dog	tiger

3. Explain why it is possible for the scientific name of an organism (its generic and specific names) immediately to tell a biologist the family, order, class, and phylum to which the organism belongs. _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. Check over the classification that you made of 24 animals in Section I. If you would now classify these animals in a different way, indicate your new classification in the space below.

Classification of Animals

Group I	Group II	Group III	Group IV	Group V

3. How would you now answer those questions which you yourself raised in Section I?

4. State briefly the chief advantages of having a comprehensive system of classification for living things. _____

Name _____ Date _____ Class _____

Chapter 10: How Are Living Things Adapted for Food-Getting?

All living plants and animals must obtain food. This is done in various ways. Sometimes the structure or form of a living organism, or of some of its parts, is such that the organism is particularly helped in food-getting. Such an arrangement is called an adaptation for food-getting.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions, write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Would you expect the mouth parts of a grain-eating animal, of a grass-eating animal, and of a flesh-eating animal to be similarly formed? _____ Explain. _____

2. A squirrel's mouth parts are adapted to the type of food the squirrel eats. Would it be proper to say that some of the squirrel's *habits* are adaptations for food-getting? _____ Tell why or why not. _____

3. How do the feet and/or legs of ducks, geese, swans, and other aquatic fowl differ in form

   (1) from those of chickens? _____

   _____ (2) from those of cranes and herons? _____

   _____ Are these differences related in any way

   to food-getting? _____ If so, how? _____

4. Does man have any adaptations for food-getting? _____ If so, what ones can you name?

5. Would you say that man is "more highly adapted" or "more adaptable" than lower animals? _____ What is the difference?

_____

_____

_____

_____

_____

_____

6. If there are questions about food-getting adaptations of either plants or animals that you would like to have answered, use the space below for including them.

_____

_____

_____

_____

_____

_____

II. EXPLORING

Crowder, William. *Dwellers of the Sea and Shore.* New York: The Macmillan Company, 1923. This book has excellent descriptions and pictures of many strange sea animals, showing their adaptations for life in water.

Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran & Company, 1934. Book VI, pp. 823–838, gives an excellent description of the adaptations of animals for food-getting in various habitats.

Reed, W. M. and Bronson, W. S. *The Sea for Sam.* New York: Harcourt, Brace and Company. This book tells about the origin of oceans and life in them—sponges, mollusks, and fish. The pictures show how sea animals are adapted for food-getting.

Fabre, Henry J. *The Life of the Fly.* New York: Dodd, Mead and Company, 1913. While talking about flies, how they get food and live, Fabre has written some chapters about himself which are also well worth reading.

Maeterlinck, Maurice. *The Life of the Bee.* New York: Dodd, Mead and Company, 1901. A delightful story with observations about the unusual habits of bees.

Teale, Edwin Way. *Grassroot Jungles.* New York: Dodd, Mead and Company, 1937. A book on insects beautifully illustrated with one hundred and thirty photographs. Many adaptations for food-getting are shown.

Fleuson, S. *Grim, The Story of a Pike.* London: Knopf or Gyldendal, 1920. Tells of the habits of a pike, especially how it eats and avoids being eaten.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. Either secure the skull of a rodent such as a rabbit or a rat, or use a good diagram or photograph of one, in answering the questions below.

   How many teeth are there? _____

   Sketch an incisor in the space below.

   Sketch a molar in the space below.

   How does the rodent use its incisors?

   How does the rodent use its molars?

2. Either secure the skull of a carnivorous animal, such as a dog or a cat, or examine the mouth parts of one. Keep in mind the food habits and mouth parts of the rodent and note the differences you find between those and the mouth parts of the carnivore. How many teeth are there? _____ How does this number compare with the number found in the rodent skull? _____
   Are the incisors as large and powerful in the carnivore as they were in the rodent? _____ Explain any difference or similarity in size. _____

   Sketch a carnivore canine tooth in the space below.

   Sketch a carnivore molar tooth in the space below.

How does the carnivore use its canines? How does the carnivore use its molars?

3. Either secure the skull of a herbivorous animal, such as a cow or a sheep, or use diagrams or photographs of one. Can you find canine teeth in a herbivore?

Explain why.

Sketch a herbivore molar in this space. How are the molars of a herbivore used?

4. Adaptations for food-getting are very common in animals. For example, you will easily observe two main types of mouth parts in insects. Examine a number of common insects such as moths, butterflies, beetles, grasshoppers, and determine whether they have biting or sucking mouth parts. Record your observations in the space below. Note whether biting insects have jaws that move up and down or sideways. Explain your observations after observing a grasshopper feeding on a blade of grass.

Insect	Type of mouth parts	Probable kind of food

Name _____ Date _____ Class _____

5. List four different ways by which birds get their food. Describe or sketch the kind of beak which would be appropriate to each way. Then name one or two birds which have the kind of mouth parts listed.

How food is obtained	Description of beak	Birds

6. Examine living protozoa and fixed slides of protozoa under the microscope. Remember that these are one-celled animals. Would you expect to find adaptations in a single cell? _____ Why? _____

The amoeba. Examine the living amoeba, if possible. Otherwise use a fixed or prepared slide. Do you see any special adaptations? _____
Refer to your text or other references to determine if amoebae display any food-getting behaviors that might be called adaptations. Summarize briefly your findings. _____

The paramecium. Using your text or other reference as a guide, examine a living paramecium under the microscope. Observe carefully its actions. Explain how the paramecium gets its food. _____

Which protozoan (amoeba or paramecium) is the more highly adapted for food-getting? _____ Is there evidence from your study of these protozoa that single cells might be highly adapted? _____ If so, what evidence? _____

7. Using suitable references, determine the adaptations that the following sea animals (sponge, fish) and parasitic animals (tapeworm, trichina) have for food-getting.

Animal	Adaptations
Sponge	
Fish	
Tapeworm	
Trichina	

8. In what ways is man adapted to obtain food? _____

Name _____ Date _____ Class _____

9. Would you say that man is more highly or less highly adapted for food-getting than is a carnivore, such as a lion? _____ Is he more or less highly adapted than the lion for changing the conditions of food supply? _____

IV. TESTING

1. In the right column are listed some animals which have structural adaptations for food-getting. In the left column are listed adaptation structures or descriptions of adaptations. Match the animal with its special adaptation by placing the number of the animal on the space in front of the adaptation.

_____ long neck	(1) chicken
_____ well developed canine teeth	(2) cow
_____ tongue attached at front, free in back	(3) frog
_____ sturdy blunt beak	(4) hawk
_____ well developed (gnawing) incisor teeth	(5) giraffe
_____ long tentacles	(6) grasshopper
_____ sucking mouth parts	(7) plant louse (aphid)
_____ hooked beak and sharp claws (talons)	(8) rat
_____ cilia to whip food through pores of body wall	(9) sea anemone
	(10) sponge
	(11) wolf

2. Write in your own words a definition for each of the following.

Adaptation: _____

_____

_____

Environment: _____

_____

_____

Habitat: _____

_____

_____

3. Would you say that man's hands are *more highly adapted* than they are *adaptable?* _____ Explain. _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Now that you have studied adaptations for food-getting, are there any generalizations about their occurrence which you can make? Any which indicate the extent among living things of food-getting adaptations? Any which indicate the usefulness of such adaptations? Try to state at least three generalizations.

Name _____ Date _____ Class _____

Chapter 11: How Are Living Things Adapted for Protecting Themselves?

Food-getting adaptations are only part of the story of adaptation for living a normal life span. The title for this chapter suggests another part of the story. Adaptations for protection involve protection from other animals and from unfavorable natural factors such as excess rain, drought, heat, and wind. They also involve safe and sure means of reproduction. In this chapter we will explore some of the adaptations which enable plants and animals to cope with difficulties other than those concerned with food-getting.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions, write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Did you ever try to pick a thistle blossom? How is it protected? _____
   Name three other plants and indicate ways in which they are protected.

   _____

   _____

   _____

2. List some common ways by which animals are protected from their enemies. _____

   _____

   _____

   _____

3. What difficulties would a five-year-old child have if he were trying to live in a forest inhabited by wild animals? _____

   _____

   _____

   What adaptations would help him? _____

   _____

   _____

4. What questions about adaptations for protection would you like to have answered?

   _____

   _____

   _____

II. EXPLORING

Parker, Bertha Morris. *The Basic Science Education Series* pamphlets entitled: *Reptiles*, 1942; *Fishes*, 1941; *Insects and Their Ways*, 1941; *Birds*, 1941; *Living Things*, 1941. Evanston, Illinois: Row, Peterson and Company. In each of these 36-page pamphlets adaptation structures and habits are discussed in an accurate and extremely interesting way. Each pamphlet is beautifully illustrated.

Huxley, Julian S. and Andrade, E. N. *Simple Science*. New York: Harper & Brothers, 1935. For examples of how the adaptations of animals are beneficial to them, see Chapter VII.

Daglish, Eric Fitch. *Animals in Black and White*. New York: William Morrow & Company, 1938. Shown in this book are pictures of many kinds of animals—birds, reptiles, and fish. Look for their special adaptations.

Sanderson, I. T. *Animal Treasure*. New York: The Viking Press, 1937. A vivid description of rare adventures in Africa while exploring for strange animals. The author's drawings of the animals are excellent, and you'll see and read about how these animals protect themselves.

Wheeler, R. E. *Social Life Among the Insects*. New York: Harcourt, Brace and Company, 1923. This book shows that many of the social habits of insects are for protection. Chapter IV has a good description of how ants live.

Akeley, Carl E. *In Brightest Africa*. Garden City: Garden City Publishing Company, 1932. An explorer describes stirring adventures with wild animals.

Johnson, Osa. *I Married Adventure*. Philadelphia: J. B. Lippincott Company, 1940. The lives and adventures of Martin and Osa Johnson.

Ward, Harold (Ed.). *New Worlds in Science*. New York: Robert M. McBride & Company, 1941. Read Part I, Section 3, the exciting story of what happens when a restless colony of ants goes on the warpath.

Fabre, J. H. *The Life of the Spider*. New York: Dodd, Mead and Company. Excellent descriptions of several kinds of spiders by one of the best of all insect observers. You will learn here how they are adapted for food-getting and protection.

Wells, Huxley, and Wells. *The Science of Life*. New York: Doubleday, Doran & Company, 1934. Many dozens of examples of adaptations for protection—mimicry, bluff, poisons, etc. are described in pages 839–960.

III. DOING AND RECORDING

Part I—Animals. Study living animals as well as reference books for help with these exercises.

1. How do cats protect themselves from unfriendly dogs?

_____

_____

2. Name some bird and describe its defense of its nest.

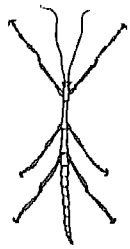
_____

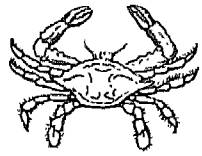
_____

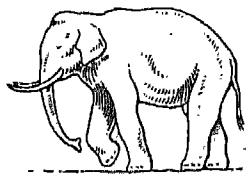
_____

Name _____ Date _____ Class _____

3. Below is a series of animal drawings. What structures seem to be particularly suited for protection in each case? Fill in all the information called for in the table.







	Adaptations for protection	How each adaptation affords protection
	Animal:	
	Habitat:	
	Animal:	
	Habitat:	
	Animal:	
	Habitat:	
	Animal:	
	Habitat:	
	Animal:	
	Habitat:	

4. Below is a list of animals which survive without [illegible] Find out how these animals are adapted for protection and [illegible]

Animal	
Preying mantis	
Viceroy butterfly	
Tomato worm moth	

5. Life habits of animals which live in certain [illegible] differ greatly. Specialized structural adaptations have been developed [illegible] somewhat different animals that live in each kind of environment [illegible] Then tell what adaptations they have and describe the conditions which [illegible] adaptations necessary.

Habitat and animals	Protective adaptation [illegible] [illegible] adaptations necessary
(1) Shallow fresh water a.	
b.	
(2) Deep ocean areas a.	
b.	
(3) Hot deserts a.	
b.	
(4) Polar regions a.	
b.	

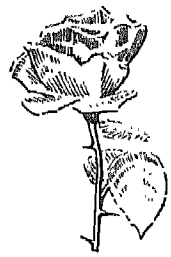
Name _____ Date _____ Class _____

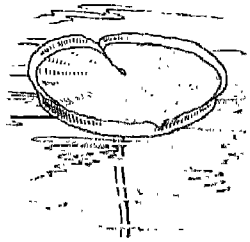
6. A study of the various animal adaptations for protection shows that there are several classes of adaptations. Name an animal that uses each of those listed below. Then tell how the adaptation functions.

Kind of adaptation	Where found	How functions
Mimicry		
Protective coloration		
Bluff or deception		
Shell or bony structure		
Ability to move fast		

Part II—Plants. Study living plants as well as reference books for help with these exercises.

7. Below is a series of plant drawings. What structures on each seem to be particularly suited for protection from natural enemies?





Adaptations for protection	How each adaptation affords protection
Plant:	
Habitat:	
Plant:	
Habitat:	
Plant:	
Habitat:	

Plant:	
Habitat:	

8. A study of the various plant adaptations for protection shows that there are several classes of adaptations. Give examples of plants having the adaptations listed below and tell how each affords protection.

Adaptation	Examples of plants having adaptation	How the adaptation affords protection
Irritating sap		
Poison sap		
Bitter taste		
Offensive odor		

IV. TESTING

1. Read the following paragraph carefully and as many times as you wish. Then answer the questions on page 77 pertaining to the paragraph.

There are localities, in the Sahara Desert, where surfaces entirely unprovided with superficial supplies of water, and ordinarily sterile, are nevertheless, after a storm, susceptible of becoming a particular kind of pasturage, known to the Arabs as "ashab" pastures. The term *ashab* does not refer to any one particular plant, but rather to a type of vegetation, the most abundant species belonging to the mustard family, but all of them have developed special tactics of their own for combating the prevalent dryness. Their survival is through the agency of their seeds, which have the faculty of resisting even extreme drought for an almost indefinite period. Should a heavy rain fall, in an astonishingly short number of days the seed of the ashab germinate, stems are pushed up, flowers are spread out, and new seed are formed. There is no time to be lost, and the ashab is so organized as to make the very best possible use of the exceptional godsend. Then, after a brief existence, the ashab dies; but the new seed, carried by the wind, covered with sand, wedged under a stone or in some crevice of rock, will wait, ten years if need be, for the next storm. During their short span of life, however, these plants, whose every effort is expended for the purposes of reproduction, have been veritable bouquets of flowers; and these clumps of flowers are the pasturage. The camels are very partial to them, and it is a ludicrous sight to see the delicate blossoms swallowed up by their filthy jaws.

—Adapted from Gautier, E. F., *Sahara*, pages 20–21, by permission of Columbia University Press.

Name _____ Date _____ Class _____

(1) Place an X in front of the ending which most correctly completes the following incomplete statement.

The chief thought of the adapted paragraph on page 76 is that

____ camels depend upon plants for food.
____ desert pasturages develop from plants that grow rapidly in the presence of water.
____ it is a ludicrous sight to see camels eat.
____ ashab is really a kind of mustard plant.
____ the seeds of the ashab can live for many years.

(2) Using only the evidence *which is given in the paragraph*, mark each statement T if it is true and X if it is false.

____ Pasturages in the Sahara develop only where there is a constant supply of surface water.
____ An "ashab" pasture is made up of several kinds of plants.
____ The seeds of the ashab grow very rapidly.
____ The ashab knows when drought is going to prevail.
____ Scattered clumps of desert flowers developed from quickly growing seeds form a pasturage.
____ Storms occur every ten years in the Sahara.
____ The ashab, if need be, will live for years.
____ Plants of an ashab pasturage are chiefly concerned with reproduction.

(3) From your reading of the paragraph decide which lettered item has most nearly the meaning of the italicized word and place its letter in the parentheses.

( ) *ashab*
a. Arab b. pasturage c. susceptible d. mustard

( ) *tactics*
a. thorns b. seeds c. arrangements d. prevalence

( ) *faculty*
a. survival b. ability c. agency d. seed

( ) *ludicrous*
a. veritable b. adaptive c. juicy d. comical

2. Notice that each human eye is set in a bony socket. Do you consider this a protective adaptation? _____ Why? _____

_____

3. What is the difference between protective coloration and protective resemblance? _____

_____

_____

_____

4. Read the following statements carefully:

Bears and certain other animals hibernate during cold seasons.
When warm blooded animals get cold they try to warm themselves by shivering.
Cactus plants can live in the desert because their thickened leaves check evaporation of water.

Check (√) the *one* general principle given below that all of these statements best illustrate.

____ When plants or animals meet unfavorable conditions, they adapt themselves in order not to be destroyed.
____ Birds and other animals change their habits.
____ Plants and animals can live under all conditions.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. Make any additions or corrections that are needed.

2. How would you now answer those questions which you yourself raised in Section I?

3. Write a number of principles that you believe would hold true concerning ways by which living things are adapted for protection.

Name _____ Date _____ Class _____

Chapter 12: How Are Certain Insects Adapted for Communal Living?

It has been said by certain scientists that, of all animals, the vertebrates and the arthropods have attained the most outstanding success, and that *man* leads the vertebrates while *insects* lead the arthropods in this respect. Whether or not you accept this opinion depends, of course, upon your notion of success. If the ability or tendency to live cooperatively in communities indicates success, then we know that certain men and certain insects are extremely successful, some more so than others. Some insects, on the other hand, are very solitary in their habits. Only a few kinds live in true communities. The most highly developed insects in the matter of community living are ants, bees, and termites. In this chapter we are going to explore the habits of some of these insects and see in what ways they are adapted for the lives they live.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each question, write your best *present* answer. An intelligent guess may be the best you can do in answering some of the questions. In Section V you will have opportunity to revise these answers.

1. What habits can you suggest that would cause the common red ant to be classified as a communal insect? _____

2. What do you know about the ways in which a bee-hive community is "run" or managed by the bees themselves? _____

3. Are the communities and habits of all communal insects nearly the same? _____ What evidence can you give to support your answer? _____

4. Bees and ants vary little in behavior from generation to generation. In what ways do man's habits differ from those of ants and bees? _____

5. What questions about adaptations for communal living would you like to have answered?

II. EXPLORING

Parker, Bertha Morris and Emerson, Alfred E. *Insect Societies*. Evanston, Illinois: Row, Peterson and Company, 1941. An interesting, fully illustrated, and accurate 36-page pamphlet about communities of wasps, bees, ants, and termites.

Fabre, Jean H. *Insect Adventurers*. New York: Dodd, Mead and Company, 1939. A group of exciting stories about bees, wasps, and other insects.

Hingston, H. *Problems of Instinct and Intelligence*. New York: The Macmillan Company, 1926. Kinds of behavior in insects are illustrated with accounts of first hand observations.

Howard, L. O. *The Insect Book*. New York: Doubleday, Doran & Company, 1901. A popular account of bees, wasps, ants, grasshoppers, flies, and other North American insects. See especially page 25 for a discussion of the social wasps and their allies.

Maeterlink, Maurice. *The Life of the Bee*. New York: Dodd, Mead and Company, 1901. A narrative, non-technical account of bees.

Maeterlink, Maurice. *The Life of the White Ant*. New York: Dodd, Mead and Company, 1927. A highly readable story of the life of a social insect.

Verrill, A. Hyatt. *Strange Insects and Their Stories*. Boston: L. C. Page and Company, 1937. A fascinating account of insect bugaboos, the insects' undertakers, and the other oddities of insect life.

Wheeler, W. M. *The Social Insects*. New York: Harcourt, Brace and Company, 1928. The behavior of ants, termites, bees, wasps, beetles, all examples of social insects, is accurately described.

III. DOING AND RECORDING

1. What do you understand the word *commune* to mean? _____

   _____

   What is meant by *communal living?* _____

   _____

   By *solitary living?* _____

2. What are some of the things that people do and that they expect others to do when all are living together in a community? _____

   _____

   _____

   _____

   _____

3. What are some of the adaptations or qualities of man which enable him to live successfully in a social group? _____

   _____

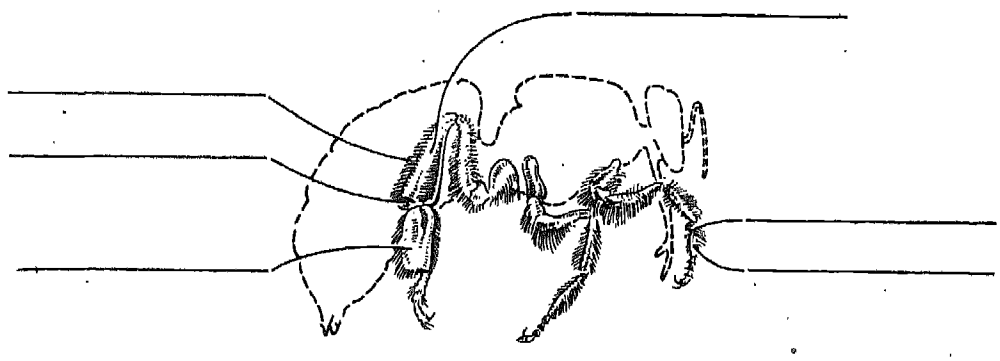
   _____

   _____

Name _____ Date _____ Class _____

4. Below is a sketch of a worker bee. Use your text and available references to help you in identifying each labelled part. Then, in the space provided, indicate how each part is adapted for some special function. For example, certain structures of the bee are adapted for gathering pollen. Label those structures and tell *how* they are so adapted.

Structure	Special function and how adapted
(1) _____	_____
(2) _____	_____
(3) _____	_____
(4) _____	_____
(5) _____	_____



5. Working with a group of other students, set up an ant colony in the classroom. (See paragraph 5, "Ants," in *To Help You in Your Study of Biology*, page vii.) Watch the ants work. Record any changes in the kinds of activity you see going on from the time you set up the colony until the ants seem to have established a permanent routine.

Observations: _____

6. To understand the nature of the behavior of social insects, study carefully the life habits of three kinds: ants, bees, and termites. By observation, reading, and discussion, and by drawing upon your present knowledge, decide how best to fill in the blanks in the table. It will require careful and thoughtful work to get the information called for into a form which "fits" concisely into the space provided.

Adaptations concerned with the habitat, habit, or process listed in the first column of the table

Items to be observed or determined and recorded	Ant	Honeybee	Termite
Habitat or home			
Membership in the social group			
How each kind of member is produced			
How young are cared for			
How food is obtained			
How food is stored			
Work of each kind of member			
How new colonies start			
Attitude toward foreigners			
Means of defense			
Is group beneficial or harmful to man? Give details.			

Name _____ Date _____ Class _____

7. The very complex life history of an insect can be shown by tracing it through its developing stages. The honeybee in its development passes through egg, larval, pupal, and adult stages. Choose either a *worker bee*, a *drone*, or a *queen* and give the information called for below.

Kind of Bee: _____

Egg:

Fertilized or not _____

Where laid _____

How cared for _____

Larva:

Where it hatches _____

How fed _____

What it eats _____

Length of time it remains a larva _____

Pupa:

Its physical shape or form _____

How it emerges _____

Summarize information about the adult of the particular kind of bee you chose to write about. _____

8. In your reading and discussion concerning social insects you probably have run across several new words. Here are some which may have appeared. What do they mean? Answer in your own words.

(1) Instinct: _____

_____

(2) Reflexes: _____

_____

(3) Intelligence: _____

_____

(4) Learned behavior: _____

_____

(5) Habit: _____

_____

(6) Castes: _____

_____

(7) Soldiers: _____

_____

(8) Sperm: _____

_____

(9) Parthenogenesis: _____

_____

(10) Division of labor: _____

_____

9. Distinguish between communal living and symbiosis. _____

_____

_____

_____

_____

Name _____ Date _____ Class _____

IV. TESTING

1. Place *A* before any of the following statements with which you agree, *D* before any with which you disagree, and *U* if you are uncertain. The truth or falsity of some of the statements has been determined. There may not be enough evidence concerning others so that we can know for certain what is true. Try to find evidence to support your "agreements" and "disagreements." Do not indicate that you are uncertain until you have reviewed evidence on the question.

   ____ All insects live communal lives.

   ____ Some kinds of organisms cannot live unless they work together in a community.

   ____ Frequently individual hive bees go away from the hive and live as solitary bees.

   ____ Most hives of honeybees maintain only one adult queen.

   ____ It is a sign of good luck to have bees swarm on your place.

   ____ The division of labor in an ant colony is planned by the queen ant.

   ____ The behavior of bees is, for the most part, instinctive.

   ____ It would be better for man were he guided entirely by instinct.

   ____ Termites are more destructive in tropical regions than they are in temperate ones.

2. Three of the items in each of the following groups are related as to function, kind, mode of living, or in some other way. Draw a circle around the unrelated word in each group.

(1) pollen	honey	bee bread	beeswax
(2) queen bee	worker bee	drone bee	female bee
(3) solitary wasp	honeybee	termite	ant
(4) egg	larva	pupa	tibia
(5) soldier ant	worker ant	nursing ant	queen ant

3. Two items in each of the following groups have a special relationship to each other—one depending on the other. Draw circles around these two items in each group.

(1) bees	ants	wasps	aphids
(2) tibia	pollen basket	tarsus	proboscis
(3) communal living	solitary wasp	flies	bees
(4) protozoa (flagellates)	honey	aphids	termites
(5) reproduction	worker	queen bee	larva

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Write two or three statements which you believe would hold true about communal insects. These statements (generalizations) may be about adaptations, about habits of community life, or perhaps about the application of our knowledge of communal insect life to the life of people in human communities. Be careful about the last point. Remember the great differences in behavior possible in insects and in human beings.

Name _____ Date _____ Class _____

Chapter 13: How Are Nongreen Plants Adapted for Food-Getting?

You have already studied how green plants make their food by the use of chlorophyll in the leaves. There are many plants, however, which do not possess chlorophyll and so can not manufacture their own food. Mushrooms, toadstools, and molds are examples with which you are familiar. They are called nongreen plants. Some nongreen plants are very harmful because they destroy man's food supplies or because they cause disease. Others are useful because they serve as food or in the preparation of food. Several of them are important because of their use in commercial processes. Since nongreen plants are so important and since they introduce so many problems into man's life, it is of value to know something about their adaptations for life, how they are useful, and how they are harmful to man.

I. DRAWING ON WHAT YOU ALREADY KNOW

You will notice that no space has been left after any of the following questions. Although you might be able to answer some of them now, no responsibility for answering them will be placed upon you until after you have had opportunity to "explore" and do other exercises called for in Sections II and III of this workbook and in your text. Read the questions carefully, think about them and keep them in mind. Then see if you can answer them as part of your test on this chapter.

1. What are some of the useful nongreen plants which are found in your community? What are some of the harmful nongreen plants found there?
2. Do you know of any *green* plants which manufacture only part of their food by means of chlorophyll?
3. The nongreen plants are usually classified as *fungi*. What group of green plants would the *fungi* most closely resemble?
4. How do molds, mushrooms, bacteria, and other nongreen plants reproduce?
5. What are some of the agricultural crops which are affected by parasitic fungi?
6. What foods are frequently affected by fungi?
7. What would be the appearance of the surface of the earth if it were not for the presence of bacteria and other nongreen plants?
8. What environmental conditions are most conducive to the development of bread mold?
9. What is meant by parasitism? By saprophytism?
10. What other questions do you wish to have answered in your study of nongreen plants?

II. EXPLORING

Brown, William H. *The Plant Kingdom.* Boston: Ginn and Company, 1935. A very extensive study of the fungi—molds, yeasts, mildews, toadstools, etc. A botany textbook discussion.

Downing, E. R. *Our Living World.* Chicago: The University of Chicago Press. Chapter X has a good discussion of the fungi and other spore-bearing plants.

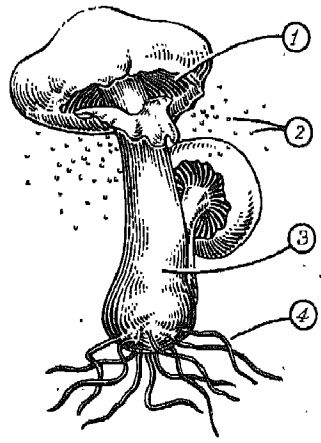
Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran & Company, 1934. The nongreen plants are discussed on pp. 275–310.

Rolfe, R. T. and Rolfe, F. W. *The Romance of the Fungus World.* Philadelphia: J. B. Lippincott Company, 1926. An excellent account of fungus life in all its guises, both real and legendary. Poisonous and edible fungi are described.

McCubbin, W. A. *Fungi and Human Affairs.* Yonkers, New York: World Book Company, 1924. Certain of the fungi are edible, but many are poisonous. This book tells about both kinds.

III. DOING AND RECORDING

1. In order to become familiar with the structure of a typical nongreen plant, label the parts of the mushroom in the diagram given here.



Parts

1. _____
2. _____
3. _____
4. _____

2. Examine some ripe, black bread mold under the microscope. Sketch some of the structures observed. Label parts of the mold sketched and describe the function of each part labelled.

Parts	Function
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Name _____ Date _____ Class _____

(1) How do bread mold and mushrooms resemble each other structurally? _____

_____

_____

How do they differ structurally? _____

_____

(2) How does bread mold obtain food? _____

_____

(3) Is bread mold an example of a parasite or a saprophyte? _____

Why? _____

(4) What conditions are favorable for the development of bread mold? _____

_____

3. In the first column of the following table are listed some common kinds of nongreen plants. Indicate for each one the information called for in the other columns. On a separate sheet of paper, list other common fungi which you know about and give the same information for them. You will need to use references to do this exercise.

Nongreen plant	Host or substratum	Nature of damage or of good which plant does	Effective control or remedy (if plant is harmful)
mildew			
wheat rust			
lichens			
corn smut			
mold			
bracket fungus			
apple rust			
toadstools			
puff balls			
tuberculosis bacteria			

4. Do saprophytic plants secrete any digestive juices? _____ If so, what are these juices called? _____

What are the structures called, in saprophytic plants, which absorb the soluble foods from the substratum? _____

Do parasitic plants need to digest any of the food they obtain from their host? _____

Why? _____

5. There are some plants which require nitrogen in addition to the starches and sugars which they can manufacture by photosynthesis. As a rule, these plants are *carnivorous*.

What is meant by *carnivorous?* _____

Two carnivorous plants are the *pitcher plant* and the *Venus's flytrap*. Describe briefly how each of these plants is adapted to obtain food by means other than photosynthesis.

Pitcher plant: _____

_____

_____

Venus's flytrap: _____

_____

_____

6. In the left hand column, list some of the methods used by housewives or by manufacturers of food products to insure that foods will keep a reasonable length of time. Then tell how each method functions in delaying or preventing the growth of "spoiling" agents.

Method of food preservation	How it discourages or prevents growth of bacteria, mold, fungus, etc.

Name _____ Date _____ Class _____

7. It is almost impossible to name all of the characteristics which identify all edible mushrooms, but there are a few characteristics which authorities say indicate surely that a mushroom is poisonous. Read about both varieties and list some of the features of poisonous ones. Some poisonous mushrooms are characterized by—

(1) _____ (4) _____

(2) _____ (5) _____

(3) _____ (6) _____

What are the difficulties involved in trying to tell whether mushrooms have the features you have listed? _____

_____

_____

IV. TESTING

1. In order to determine whether you have a clear understanding of the important words in this chapter, write your own definition or explanation of the following words. If you are not certain of their meanings, consult your text or a reference book. If there is any word which you have not studied, look up its meaning and determine how it is related to the study of nongreen plants.

Scavenger: _____

Parasite: _____

Saprophyte: _____

Enzymes: _____

Mycelium: _____

Spore: _____

Host: _____

Substratum: _____

Photosynthesis: _____

Insectivores: _____

Decay: _____

Bacteria: _____

2. Choose the ending which completes each of the following incomplete statements correctly. Write its letter on the blank before the statement.

____ All nongreen plants are (a) parasites (b) saprophytes (c) fungi (d) weeds (e) molds.

____ The pitcher plant obtains some of its food from insects because it is unable to manufacture sufficient quantities of (a) chlorophyll (b) nitrogen (c) mold (d) sugar (e) spores.

____ The portions of a mushroom which absorb soluble substances for food are called (a) mycelium (b) gills (c) fungi (d) stalks (e) enzymes.

____ The result of bacterial action on organic material is usually known as (a) rusting (b) decay (c) photosynthesis (d) oxidation (e) digestion.

____ The spores of fungus plants help the plant in (a) reproduction (b) digestion (c) photosynthesis (d) locomotion (e) eating.

3. On a separate sheet of paper write answers to the questions in Section I. Attach your answers to this page.

V. SUMMARIZING

1. How would you now answer those questions which you yourself raised in Section I?

2. What generalizations can you now make about the adaptations of nongreen plants for food-getting? Write several statements which you believe would hold true for nongreen plants in general.

Name _____ Date _____ Class _____

UNIT III. HOW THE BODY USES FOODS AND REMOVES WASTES

Chapter 14: How Are Foods Prepared for Use in the Cells of the Body?

We now need to see how the various foods are made of use to our bodies. If we know something of the values of food and of the preparation of food for use in our bodies, we should be able to keep our bodies more healthy.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. What is digestion? _____

_____

2. Do all animals have digestive systems? _____

3. What, in your opinion, are causes of "indigestion"? _____

_____

4. Suggest proper remedies for indigestion. _____

_____

5. What, in your opinion, are causes of "constipation"? _____

_____

State your present opinion as to the relation between constipation and headaches. _____

_____

_____

Suggest proper remedies for constipation. _____

_____

6. How might enzymes function within the human body? _____

7. What other questions in connection with digestion would you like to have answered?

_____

_____

II. EXPLORING

Carlson, A. J. and Johnson, V. *The Machinery of the Body*. Chicago: The University of Chicago Press, 1937. An excellent source for knowledge of the digestive process: pp. 257-296 — "The Work of the Alimentary Tract."

Elwyn, Adolph. *The Story of the Human Body*. New York: Grossett & Dunlap, 1934. Chapter X discusses the digestion of food.

Hegner, R. W. *College Zoology*. New York: The Macmillan Company, 1937. A readable account of digestion in lower animals: the crayfish, p. 225; the frog, pp. 370-376; the pigeon, p. 541; the rabbit, p. 577.

Chandler, Asa C. *The Eater's Digest*. New York: Farrar & Rinehart, Inc., 1941. A lively account of how digestion occurs and the fate of the products formed.

Hartman, Carl. *Laboratory Manual for Human Physiology*. Yonkers: World Book Company, 1914. Many simple, effective experiments on digestion and foods are given in Sections III, IV, V.

III. DOING AND RECORDING

1. We have not always known so much about digestion as is known today. Many men have contributed their notions as to how digestion occurs. Some of the notions may seem amusing to us now. Find, by reading in your text and elsewhere, how the men named in this chart explained the process of digestion.

Person	His theory of digestion
Hippocrates	
Galen	
Dr. John Hunter	

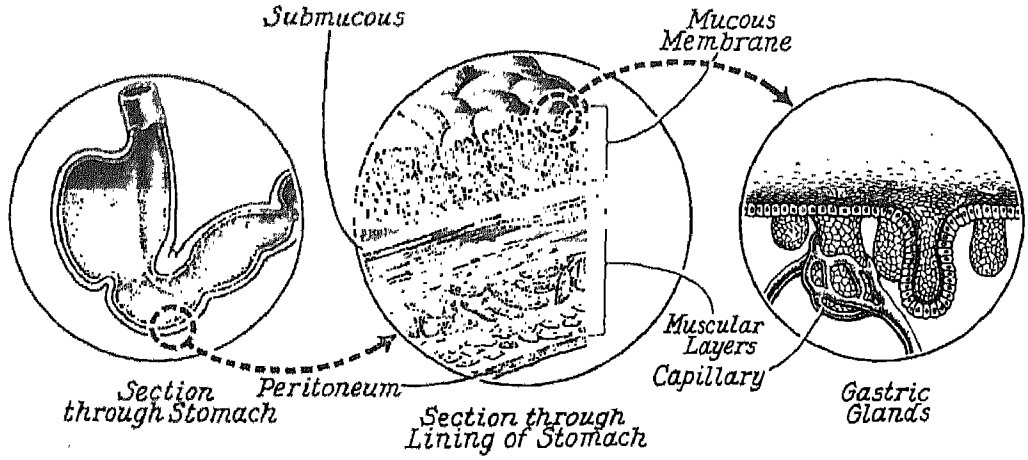
2. What contribution was Dr. William Beaumont able to make in solving the problem of digestion because of his observation of the wounded soldier, St. Martin? _____

3. Dissect out the digestive tract from a typical herbivorous animal such as a rabbit and from a typical carnivorous animal such as a cat. Study the following parts:—mouth, pharynx, esophagus, sphincters, stomach, small intestine, pancreas, and large intestine. If there still is food in the various parts of the digestive systems, note its consistency and physical appearance in each part. Record your observations in the space below and at the top of page 95. _____

Name _____ Date _____ Class _____

From your comparison of the parts of the digestive system in each animal, state briefly the chief differences between them. _____

4. Study the following labeled diagrams of the stomach. Tell briefly, in the spaces below the diagram, the function of each part there listed.



Mucous membrane: _____ Capillaries: _____

Peritoneum: _____ Gastric glands: _____

Muscular layers: _____

5. It has been learned that digestion is made to occur in each part of the digestive tract by the flow of digestive juices into them. The digestive juice of the mouth is the _____ which comes from the _____. In the stomach is found the _____. It has its origin in the _____. In the small intestine there are three secretions or digestive juices, the _____ which comes from the _____; the _____ which comes from the _____; and the _____ which comes from the _____.

6. Study the accompanying diagram which shows the parts of the human digestive system and show that you recognize each part by naming it correctly in the space provided.

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

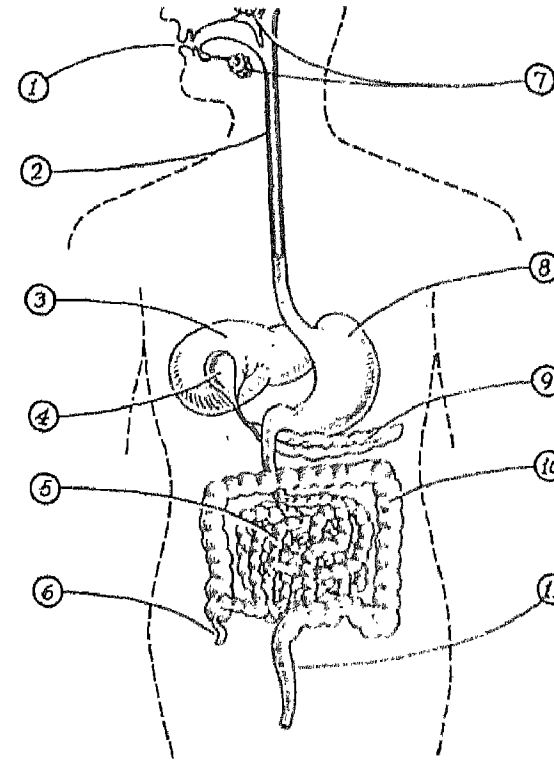
(7) _____

(8) _____

(9) _____

(10) _____

(11) _____

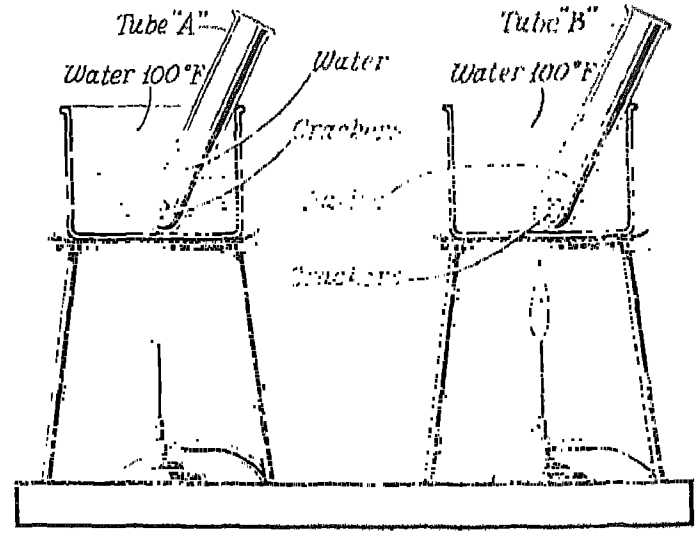


7. The following exercises will help you better to understand what happens to the food in different parts of the digestive system. First: Digestion in the mouth.

(1) Into two test tubes, A and B, place the fragments of ¼ of a soda cracker. Add *water* to A until it is about ⅓ full; add an equal amount of *saliva* to B. Shake the contents of the tubes and *immediately* take a *small* portion from each tube and test for the presence of grape sugar. (See Chapter V of this workbook.)

Results: A _____ B _____

(2) Place the tubes in a beaker of water kept at a temperature of about 100°F. Observe each tube from time to time for about half an hour. Do you see any difference in the appearance of the crackers?



_____

Now test another sample of the contents of each tube for grape sugar. What do you conclude happens to the starch? _____

_____

What appears, then, to be the function of the digestive juice in the mouth?

_____

Name _____ Date _____ Class _____

8. There are, however, other kinds of *food nutrients* besides starch (a carbohydrate) which need to be digested. What are the other food nutrients? _____ and _____

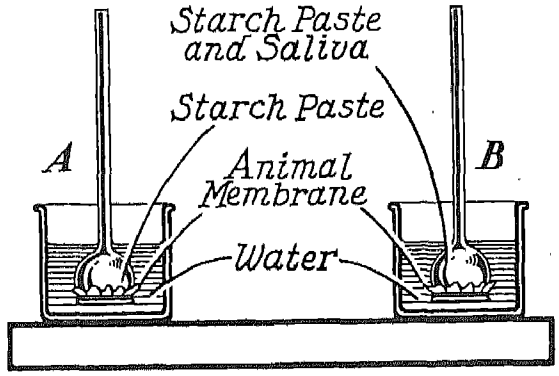
In the stomach the _____ juice acts on the _____ foods changing them chemically into simpler substances called _____ and _____.

What then becomes of these new substances? _____

_____

In the small intestines the intestinal juice, the pancreatic juice, and the bile are mixed into the foods. It has been found that pancreatic juice and intestinal juice change starch to _____. Also they act on the peptones and proteoses which have come from the _____ changing them into _____.

9. What is the *purpose* of digestion? Set up the following experiment to help answer this question. Into each of two thistle tube funnels (A and B) place a mixture of starch paste and water. Into B put about 10 cc of fresh saliva. Place a membrane (parchment, goldbeaters, or intestinal membrane) securely over the end of each funnel. Place each funnel in a different beaker or glass of warm water. After they have stood for about a half hour test a sample of the contents of each beaker for the presence of starch. Then test the contents of each beaker for the presence of grape sugar.



Is starch present in beaker A? _____ Is starch present in beaker B? _____

Is grape sugar present in beaker A? _____ Is grape sugar present in beaker B? _____

What conclusion do you draw about the comparative ability of starch and sugar to pass through a semi-permeable membrane? _____

_____

_____

How do you account for the results you observed? _____

_____

_____

_____

_____

10. We have been speaking of the digestive juices as though they did all the work of breaking food down into simpler and water-soluble foods. The truth is that each digestive juice really contains special chemical substances called *enzymes* which bring about these changes. The following chart calls for information about the digestive enzymes, where they occur, and what they do.

Organ of digestion	Digestive juice	Enzyme present	Food substances acted upon	Product or products formed
Example: mouth	saliva	ptyalin	starches	maltose (a simple sugar)

11. What are some of the possible causes of indigestion? _____

_____

Can a person be sure, even if he has what seems to be indigestion, that the remedies advertised over the radio and in the papers will do him any good? _____

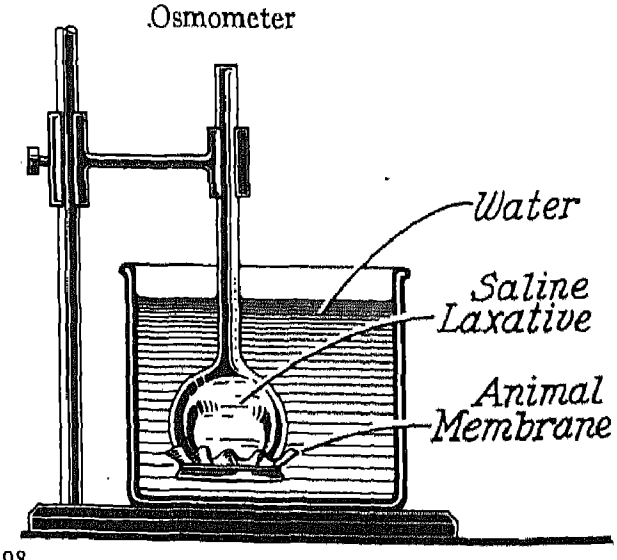
Explain. _____

_____

12. Observe the action of saline type of laxative by placing a strong solution of a commercial saline laxative in a thistle tube and fastening an animal membrane over the mouth as shown in the drawing. Place in a beaker and observe results. At the left of the drawing indicate what parts in the human body would correspond to parts of the osmometer.

Corresponding parts of human body

Osmometer



Name _____ Date _____ Class _____

What would be the action of saline laxatives in the human intestinal tract? _____

_____

_____

_____

_____

13. Make a special study of the dangers and benefits which are associated with the use of laxatives. Talk to your family doctor, your school nurse, or other persons who suggest remedies and see what they have to say on the subject. Write up a summary of your study and attach it to this page.

IV. TESTING

1. Place an X in the blanks before the endings which correctly complete each of the following incomplete statements. You may need to select more than one ending in each group.

(1) Digestion may be considered a process which

____ makes food substances soluble in water.
____ circulates the food throughout the body.
____ occurs in several organs of the body.
____ breaks down food substances into simpler substances.
____ enables animals to manufacture their own food.

(2) During the process of digestion foods pass from

____ the stomach to the esophagus.
____ the mouth to the esophagus.
____ the stomach directly to the large intestine.
____ the large intestine to the small intestine.
____ the small intestine to the large intestine.

(3) Peristalsis is a process which occurs

____ in the esophagus, to carry food to the stomach.
____ in the large intestine, to help digest food.
____ in the small intestine, to force the food along.
____ in the stomach to mix food.
____ in the rectum, to aid in elimination.

(4) The pancreatic juice

____ comes into the stomach from the liver.
____ empties into the small intestine.
____ contains an enzyme called ptyalin.
____ contains an enzyme called trypsin, which digests proteins.
____ contains an enzyme called amylopsin, which changes complex sugars to glucose.
____ is really the same as the gastric juice.

(5) The small intestine in man

____ is the region in which most of the starches are digested.
____ is much longer than the large intestine.
____ is separated from the stomach by the cardiac sphincter.
____ produces the gastric juice.
____ permits the absorption of digested food into the blood stream.

2. Most words are defined by first assigning them to a general class. For example, we say, "A *desk* is a piece of *furniture*——," *furniture* being a more general word than *desk*. In each group below, select the two most closely related words, then draw two lines under the general word and one line under the specific word as shown here: hat, <u>desk</u>, cow, <u>furniture</u>

(1) enzyme	pancreas	ptyalin	bile
(2) butter	bread	fat	honey
(3) mouth	starch	soda cracker	iodine
(4) protein	starch	egg white	digestion
(5) divisive action	pancreatin	digestion	gastric juice
(6) gland	pancreas	enzyme	digestion
(7) mineral oil	fat	peristalsis	laxative
(8) herbivore	cow	cat	herb
(9) man	omnivore	plant	carnivore
(10) starch	ptyalin	sugar	glucose

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which you now believe to be true concerning digestion.

Name _____ Date _____ Class _____

Chapter 15: How Are Foods Distributed to the Cells?

Our study of the digestion of foods has given few clues as to how foods are absorbed by cells in the body tissues. Yet we know that our bodies grow, have energy, and keep alive because food reaches the body cells. The exercises in this section will help you in understanding how this is done.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions, write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Of what is blood composed? _____

2. How does the blood circulate through the body? _____

3. How does digested food get into the blood stream? _____

4. How does man's circulatory system differ from that of a frog? _____

5. Describe the functions of a vein, an artery, and a capillary in such a way that their differences are apparent. _____

6. About how much blood is there in the average adult? _____

7. How long does it take the blood to circulate through the body? _____

8. What, other than food, does the blood transport to all parts of the body? _____

9. What other questions concerning circulation and the distribution of food in the body would you like to have answered?

II. EXPLORING

Carlson, A. J., and Johnson, Victor. *The Machinery of the Human Body*. Chicago: University of Chicago Press, 1937. For additional information about the blood, see Chapter III, p. 74; Chapter IV, p. 122; and Chapter V, p. 160.

Elwyn, Adolph. *The Story of the Human Body*. New York: Grosset & Dunlap, 1934. Chapter IX gives a good account of "The Transportation System" as well as some information about William Harvey.

Locy, W. A. *Biology and Its Makers*. New York: Henry Holt and Company, 1915. An excellent biographical sketch of William Harvey, including some of his ideas about circulation, is found in Chapter III.

Harvey, William. *The Motion of the Heart and Blood in Animals*. New York: Everyman's Library, E. P. Dutton & Company, 1908. Especially interesting because it is the original description by Harvey of his theory of circulation.

Hegner, R. W. *College Zoology*. New York: Macmillan Company, 1937. You may wish to know more about circulation in some of the lower animals such as the amoeba, p. 31, the earthworm, p. 196, and the frog, p. 379.

Malloch, Archibald. *William Harvey*. New York: Paul B. Hoeber, Inc., 1929. A biography of a great physiologist.

Hartman, Carl. *Laboratory Manual for Human Physiology*. Yonkers: World Book Company, 1914. Section VII describes many experiments on circulation.

III. DOING AND RECORDING

1. Before food leaves the small intestine it is, for the most part, digested. We may conclude, therefore, that the blood picks up digested food from the small intestine. This process is known as *absorption*. Secure from a nearby meat market a section of mammalian intestine and examine it closely. How is the absorbing capacity of the small intestine increased?

2. Examine a small section of mammalian small intestine under the microscope. How is the structure of the villi suited for rapid absorption?

Name _____ Date _____ Class _____

3. When food, other than fats, has been absorbed through the villi, it is carried away in small _____ which are carrying blood toward the heart. However, the blood does not go directly to the heart from the villi. It is carried along by larger and larger vessels until it reaches a large vein, the _____ _____, which leads to the liver.
4. The liver is the largest gland in the body. What is the chief function of the liver? _____

_____

_____

5. Trace the blood from the liver to the heart by filling in the blanks.

   From liver to _____ to _____ to heart.

6. Fats leave the small intestine through a set of vessels known as _____. These eventually empty into a large duct called the _____ which, in turn, joins the *superior vena cava* and enters the right auricle.
7. Now summarize briefly the routes by which sugars, amino acids, and fats reach the heart so they can be distributed through the body. In each case start with the villi.

   Sugars: _____ heart.

   Amino acids: _____ heart.

   Fats: _____ heart.

8. Obtain a beef heart from a freshly killed animal. Your local butcher may be able to obtain one for you. Observe its structure. Locate the aorta and any venous connections which were left on the heart when it was cut out. What are some of the special features of the heart? _____

_____

_____

   Trace the flow of blood through the chambers of the heart. _____

_____

   Note the structure of the valves. Name each and state its purpose. _____

_____

_____

_____

_____

9. Observe the flow of blood through capillaries by wrapping the front part of a small goldfish in a water-soaked piece of cotton and placing it on the stage of a microscope so that the tail falls on a glass plate under the low power objective. Focus the microscope carefully and observe. How does the blood seem to move? _____

_____

10. What is meant by a *leaky* heart? _____

_____

11. Tell *where* and, briefly, *how* oxygen is picked up by the blood.

_____

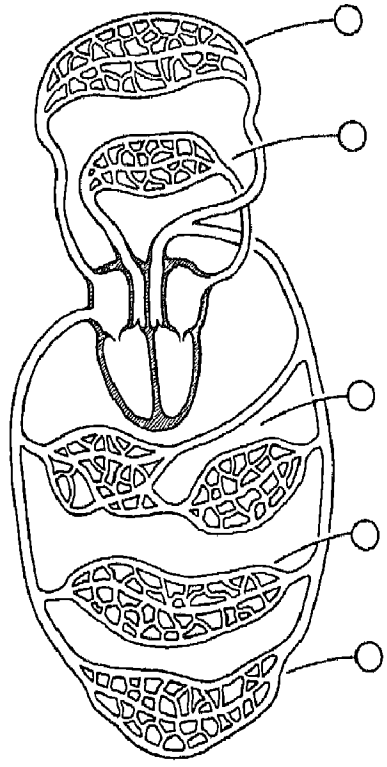
_____

12. Once the blood has a supply of food and oxygen it begins its trip away from the heart to all parts of the body. There are five general regions to which the blood goes. It is necessary, therefore, to have five more or less distinct blood paths. Name the five regions to which the five blood paths lead.

(1) _____ (3) _____

(2) _____ (4) _____

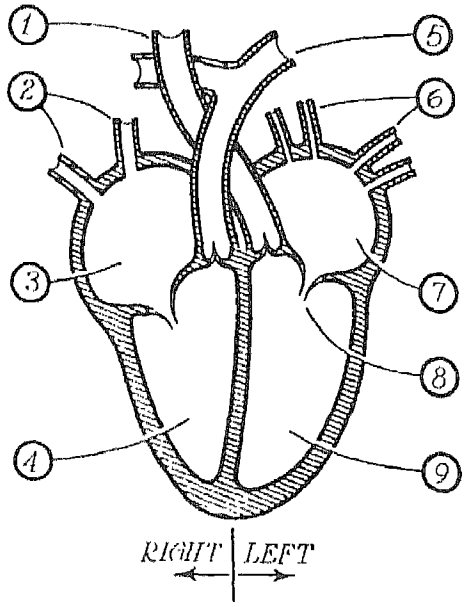
(5) _____



Place the numbers of the regions, that you have named above, in the circles from which lines lead to those regions on this diagram. Show by arrows the direction of blood flow in this diagram.

Name _____ Date _____ Class _____

13. Use arrows to show on this drawing the direction of circulation in all parts of the heart. On the lines at the right name each numbered part of the drawing.



(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

(7) _____

(8) _____

(9) _____

14. By referring to your text or other books find the information called for below.

(1) The rate of flow of blood: _____

(2) Quantity of blood in average adult: _____

(3) Meaning of systolic blood pressure: _____

_____

Meaning of diastolic blood pressure: _____

_____

(4) The normal systolic blood pressure of your age group: _____

The normal diastolic blood pressure of your age group: _____

15. Pulse rate varies in different persons. Have each member of the class take a pulse count before exercising. Record the rate per minute for each person. Then exercise vigorously for a minute and take another count. Record the rates again, being sure to keep the counts for the same person together. Keep boys' and girls' scores separate. Attach record to this page. How does exercise affect the pulse beat? _____ What conclusions can you draw from this experiment? _____

_____

_____

16. Obtain about a pint of fresh blood from a packing house or a slaughter-house. A butcher usually will permit you to open a vein of an animal and insert a glass tube. After you have collected the blood put a cover on the jar to keep the air out. Only the top portion of the blood will clot if you do not wait too long to use it. Pour some of the fresh blood into a bowl and whip it slowly with an egg-beater or fork. What happens? _____

_____

Let another portion of the blood stand in a vessel for several hours. What happens?

_____

_____

17. Examine the heart of a fish and of a frog. Sketch a two-chambered heart, as in the fish. Sketch a three-chambered heart, as in the frog. Tell how each functions.

Two-chambered heart	Three-chambered heart
How a fish's heart functions: _____	How a frog's heart functions: _____
_____	_____
_____	_____
_____	_____
_____	_____

What advantages are to be found in a four-chambered heart over a two-or three-chambered heart? _____

_____

_____

_____

_____

_____

Name _____ Date _____ Class _____

IV. TESTING

1. Place the letter of the correct answer in the blank space before each question.

____ What are the vessels which carry blood away from the heart?

a. veins
b. valves
c. arteries
d. villi

____ Which part of the circulatory system carries fats from the intestines?

a. arterial capillaries
b. venous capillaries
c. pancreatic duct
d. lacteals

____ Which part of the blood carries oxygen to the cells?

a. hemoglobin
b. thrombin
c. white corpuscles
d. phagocytes

____ In what form is sugar deposited in the liver?

a. starch
b. glycogen
c. fibrin
d. pancreatin

____ Which material clots the blood by mixing with the corpuscles?

a. thrombin
b. fibrin
c. platelets
d. white corpuscles

____ Which has the thickest walls?

a. veins
b. venous capillaries
c. arteries
d. arterial capillaries

____ What structures increase the absorbing surface of the small intestine?

a. lacteals
b. villi
c. valves
d. enzymes

____ Approximately how much blood does an adult possess?

a. 50 pounds
b. 7.5 pounds
c. 17.5 pounds
d. 2 pounds

____ Who discovered the fact that blood circulates?

a. William Harvey
b. Aristotle
c. Galen
d. Hippocrates

2. In the following condensed story of circulation fill the blank spaces with the correct words selected from the twenty-one listed on page 108. Some of these words will be used more than once.

Blood, which consists largely of _____, _____, and _____, is forced from the _____ of the heart into the aorta, a large _____. The artery branches and part of this blood is carried to the lower limbs. The very small branches of the arteries carrying blood to the cells are called _____. These branch finally into small capillaries which penetrate to the _____ spaces

between the cells. The blood gives up the food and oxygen it is carrying and picks up wastes including _____ and _____. Small veins carry the blood to the inferior vena cava which empties the blood into the _____ of the heart. The blood next reaches the _____. The blood which goes to the lungs has an excess of _____ and a scarcity of _____. When the blood leaves the lungs it has an excess of _____. Blood returns from the lungs to the _____ of the heart through the _____. The blood may not return to the lower limbs but by a different circuit it may go to the kidneys where it would lose _____. Or it might go to the alimentary canal where it might leave _____ and _____ and pick up digested _____ or _____. If it took the latter route it would return to the heart by way of the _____ where it might store some of the excess sugar as _____.

1. arterioles	6. left auricle	11. food	16. pulmonary veins
2. artery	7. left ventricle	12. oxygen	17. red corpuscles
3. carbon dioxide	8. liver	13. plasma	18. right auricle
4. nitrogenous waste	9. lungs	14. proteins	19. sugars
5. glycogen	10. lymph	15. intercellular	20. urea

21. white corpuscles

V. SUMMARIZING

1. Reread the answers you wrote to the questions in Section I. If they need to be corrected or modified make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Indicate any generalizations which you believe to be true of circulation or the circulatory system?

Name _____ Date _____ Class _____

Chapter 16: How Does the Body Do Work?

Food is necessary to give energy to the body for doing work. We know that the blood carries food to various parts of the body. But *how* is energy released? And *how* does the body machine work when energy is released? This chapter will help you to answer these questions.

I. DRAWING ON WHAT YOU ALREADY KNOW

See how well you can answer each of these questions now. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. How does our skeleton aid us in moving about? _____

2. What kinds of joints are found in the human body? _____

3. Why is energy required to release muscles for motion? _____

4. What is the diaphragm? _____

5. How is temperature regulated in the human body? _____

6. List any other questions concerned with the release of energy in the body that you wish to have answered.

II. EXPLORING

Carlson, A. J. and Johnson, Victor. *The Machinery of the Body.* Chicago: The University of Chicago Press, 1937. Chapters III and VIII give useful information about how the body does its work.

Bogert, L. J. *Dietetics Simplified.* New York: The Macmillan Company, 1940. A discussion of the food requirements for persons of different ages and conditions.

Sherman, Henry C. *Chemistry of Food and Nutrition.* New York: The Macmillan Company, 1941. An excellent standard food chemistry. See especially Chapters IX and X for information about ways in which the body makes use of food.

Clendening, Logan. *The Human Body.* New York: Alfred A. Knopf. 1928. A book fully illustrating the structure of the human body.

Hill, A. V. *Living Machinery.* New York: Harcourt, Brace and Company, 1927. See Chapters II and III for descriptions of muscles and how they work.

Brindze, Ruth. *Johnny Get Your Money's Worth.* New York: The Vanguard Press, 1938. Contains advice for boys and girls on purchasing clothes, skates, candy, etc.

III. DOING AND RECORDING

1. If a human skeleton is available use it to make observations concerning the positions of the bones in the skeletal system. Otherwise use this diagram. In either case utilize your own body to supplement your observations.

   (1) How do the arms differ from the legs in structure and in use? _____

   _____

   _____

   _____

   _____

   (2) Locate and label the different kinds of joints on the skeletal system in the diagram.

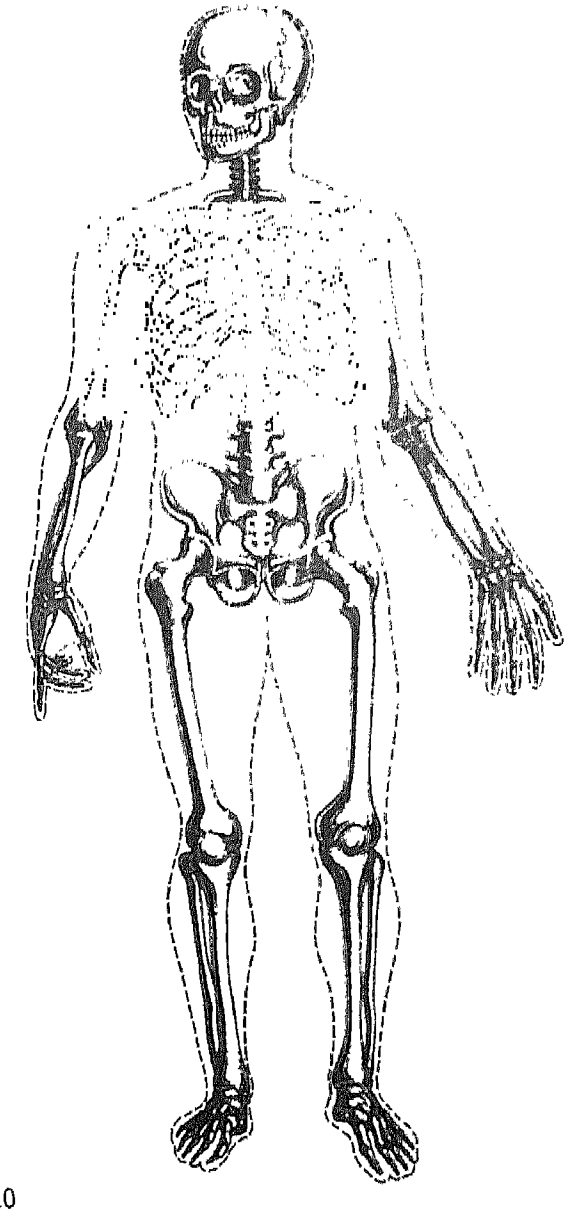
   (3) Explain how it is possible for us to rotate our hands, i.e., to turn them from palm up to palm down.

   _____

   _____

   _____

   _____



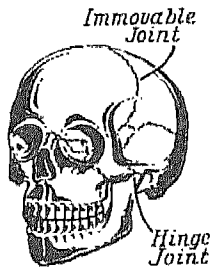
Name _____ Date _____ Class _____

2. Three kinds of joints are shown in these drawings. Describe briefly how each works.

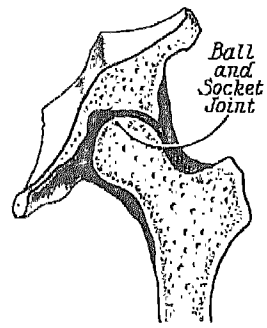
_____

_____

_____



SKULL



Section through HIP JOINT

_____

_____

_____

_____

_____

3. In order better to understand the many differences which occur in the bodies of animals, make a comparative study of the skeletons of several animals. Use either models or real skeletons, if available. Compare the bones of each animal with the counterparts in man. Record your observations on a separate sheet of paper and attach to this page.

4. Dissect a crayfish to learn how the muscles are arranged in an animal which has an exoskeleton. How are the legs attached to the body? _____

_____

How are the muscles in the legs arranged? _____

_____

Are there any muscles in the abdomen? _____ Describe arrangement. _____

_____

_____

What other muscles do you observe in the crayfish? _____

_____

5. Dissect a frog to discover how the muscles are arranged. (1) Remove the skin from the jumping legs. By means of a dissecting needle carefully tease apart the muscles which you can observe. In the space below sketch the arrangement of the larger muscles, showing how they are attached to the bones.

(2) Remove the skin from the upper and lower surfaces of the body of the frog and study the muscles which appear. Describe their arrangement.

6. The body machine is capable of exerting a force by the use of muscles. Of course, the muscles must have a source of energy. This source is fuel burned in the cells. How does a muscle, the biceps of the arm for example, enable you to lift a weight?

7. An explanation of the chemical process by which energy is liberated for muscular use involves a knowledge of several special terms which are listed here. Define each and tell its relation to the release of energy in the cells.

Glucose:

Glycogen:

Oxygen:

Insulin:

Lactic acid:

Carbon dioxide:

8. Tell specifically how the diaphragm works in inhalation (breathing in) and in exhalation (breathing out).

Name _____ Date _____ Class _____

9. Fill a large beaker with water. Into the beaker place a small amount of phenolphthalein and then drop a very small amount of weak sodium hydroxide solution into the water. The color should appear very light pink. If dark pink, add more water until it is very light pink. Then place one half the solution in each of two smaller beakers. Into one of them place a healthy goldfish for about twenty minutes. What change in color occurs?

_____

Recalling our use of phenolphthalein as an indicator (page 23), account for the change.

_____

_____

10. How do plants obtain oxygen? _____

_____

How do they release carbon dioxide? _____

_____

Explain the fallacy in this statement: "The growing of plants in a living room improves the air by causing an increase in the oxygen and a decrease in the carbon dioxide."

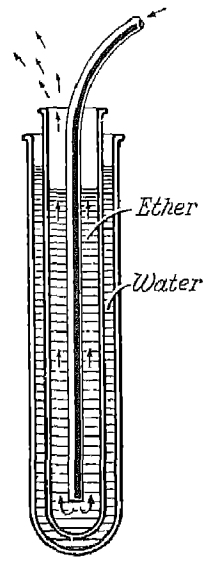
_____

_____

Under what conditions might the statement be true? _____

_____

11. The following experiment will illustrate the cooling effect of evaporation. Secure two test tubes, one of which will just fit into the other, as in the diagram. Place enough water in the larger tube so that it will fill the cavity between the two. Fill the smaller tube half full of ether. Blow through a glass tube into the ether. What happens to the water between the tubes as the ether evaporates? _____



Explain. _____

_____

_____

_____

_____

12. Study the diagram of the nasal and mouth passages, the thoracic region and the lungs of man as shown here. Then identify each numbered part.

(1) _____ (9) _____

(2) _____ (10) _____

(3) _____ (11) _____

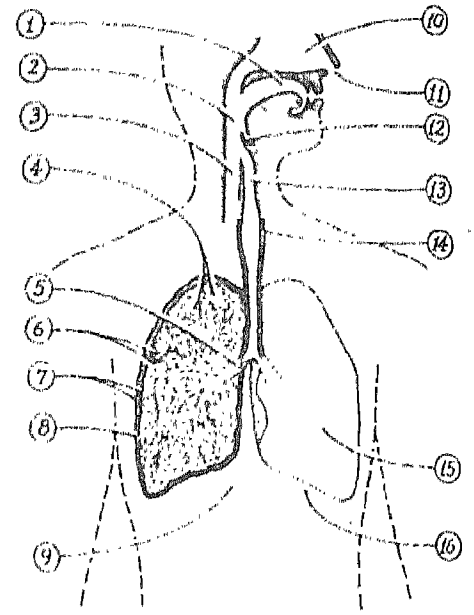
(4) _____ (12) _____

(5) _____ (13) _____

(6) _____ (14) _____

(7) _____ (15) _____

(8) _____ (16) _____



13. Water vapor from lungs and skin passes into the air in a room from the bodies of people occupying the room. Among the terms used in describing the moisture condition of air are the following. Define each.

Humidity: _____

_____

Relative humidity: _____

_____

Saturation: _____

_____

14. What is a comfortable relative humidity for a classroom?

How can an air conditioning system regulate the humidity of a room?

_____

_____

_____

15. What provision is there in our nasal passages to prevent them from becoming clogged with foreign particles, such as dust? _____

_____

_____

Name _____ Date _____ Class _____

IV. TESTING

1. Place an X on the blank before each ending which correctly completes the following incomplete statements. You may need to select more than one ending in each group.

   (1) Energy is released in the body
   - ____ by the burning of sugars within the body cells.
   - ____ by the combining of carbon dioxide with glycogen.
   - ____ in order that the muscles can do work.
   - ____ by a breakdown of the red corpuscles.
   - ____ in the form of heat and motion.

   (2) When oxidation occurs in muscle cells
   - ____ oxygen is released into the lymph spaces.
   - ____ carbon dioxide is released into the lymph spaces.
   - ____ lactic acid is produced as a waste product.
   - ____ lactic acid is broken down into carbon dioxide and water.
   - ____ white corpuscles pick up the waste products.

   (3) The temperature of the body is kept nearly constant
   - ____ by loss of heat from blood flowing near the surface of the body.
   - ____ by the liver's regulating action.
   - ____ because heat radiates rapidly from the skeletal system.
   - ____ by sweat glands which secrete perspiration.

   (4) Respiration is a process by which
   - ____ plants use carbon dioxide to make starch.
   - ____ animals exchange gases in the body cells.
   - ____ oxygen is provided to help release energy in living organisms.
   - ____ carbon dioxide is released from the organism.
   - ____ animals burn carbon dioxide.

   (5) The lungs
   - ____ are the main organs of excretion in the body of man.
   - ____ are organs for the exchange of oxygen and carbon dioxide.
   - ____ take in oxygen and give off water, carbon dioxide and heat.
   - ____ control the up and down motion of the diaphragm.
   - ____ get larger and smaller during the process of breathing.

2. Two items in each of the following groups are *not* related to the other three. Draw circles around those two. Then tell why the other three items have a common relationship.

   (1) inhalation breathing exhalation circulation digestion

   _____

   (2) lungs heart diaphragm stomach trachea

   _____

   (3) carbon dioxide water lactic acid joint red blood corpuscles

   _____

(4) energy skeleton lung force work

(5) heart lungs skin stomach gills

(6) muscles skeleton sugar oxygen joint

(7) glycogen oxygen insulin glucose carbon dioxide

(8) relative humidity snow temperature wind ventilation

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State one principle or generalization which you think important with regard to the release of energy for work.

Name _____ Date _____ Class _____

Chapter 17: Metabolism and Diet

The health of the nation depends upon having healthy individuals. Proper and adequate foods are essential for maintaining healthy bodies. We have learned that energy to run our body machines comes from food. We have not learned whether we need to eat foods and food substances which do not contribute directly to energy output. As individuals, we should know how much of the various kinds of foods is appropriate for us. In this section we shall study the findings of nutrition experts in order to help us understand our own food needs.

I. DRAWING ON WHAT YOU ALREADY KNOW

Answer each of the following questions to the best of your *present* ability. An intelligent guess may be the best you can do in answering some of them. In Section V you will be given opportunity to revise these answers.

1. Do you eat enough of the right things? _____ What is your basis for judging? _____

2. What is a Calorie? _____

3. How much heat energy do you liberate when you play basketball? _____

   When you walk? _____

4. How much energy do you expend when you are studying? _____

5. How can you determine the amount of food needed to supply your daily energy expenditure? _____

6. What part does protein play in our diet? _____

7. What are some dangers involved in trying to "reduce" too rapidly? _____

8. What other questions concerned with diet would you like to have answered? _____

II. EXPLORING

Rose, Mary Swartz. *Foundations of Nutrition.* New York: The Macmillan Company, 1938. Furnishes information about metabolism and diet. The energy requirements of children are given in Chapter V.

Harris, F. L. and Henderson, R. A. *Foods, Their Nutritive, Economic and Social Values.* Boston: Little, Brown and Company, 1938. Contains useful charts of the nutritive values of foods.

Bogert, L. J. *Dietetics Simplified.* New York: The Macmillan Company, 1940. This will help you solve your diet problems.

Rose, Mary Swartz. *Feeding the Family.* New York: The Macmillan Company, 1940. This book is written to help persons who regard their health as important, and who wish to understand the types of food necessary for keeping healthy.

Jaffe, Bernard. *New World of Chemistry.* New York: Silver Burdett Company, 1940. Chapter 36 discusses foods and vitamins.

Furnas, C. C. *Man, Bread and Destiny.* New York: Reynal & Hitchcock, 1937. An exciting analysis of the way in which man's need for foods has helped to shape history.

U.S.D.A. Yearbook of Agriculture, 1939. *Food and Life.* U. S. Government Printing Office. Several authoritative statements of the function of food in health are found in Part I Human Nutrition. An excellent source of information.

III. DOING AND RECORDING

1. To discuss the problem of food and nutrition intelligently, we need to know the meaning of the following frequently used words. By referring to your text, the dictionary, and other books, formulate a good short definition for each.

   Metabolism _____

   Diet (noun) _____

   calorie _____

   Calorie _____

   Calorimeter _____

   Basal metabolism _____

   Malnutrition _____

2. In addition to supplying necessary energy for body work, foods are needed for several other purposes. Fill in the chart to indicate purposes, other than for energy, served by each of the following types of food essentials.

Food essentials	Purpose or purposes, other than for energy.
Carbohydrates	
Fats	
Minerals	
Proteins	
Water	
Vitamins	

Name _____ Date _____ Class _____

3. In order to help you in estimating your own Calorie expenditure, you may make use of standard prepared tables such as the one below, which is taken from page 98 of *Feeding the Family* by Mary Swartz Rose. This table gives the number of Calories spent, on the average, per hour per pound of body weight.

Energy Requirements for Different Kinds of Activity

Kinds of Activity	Calories per hour per pound of body weight
Sleeping	$\frac{1}{2}$
Sitting quietly	$\frac{3}{5}$
Standing	$\frac{3}{4}$
Light exercise	1
Moderate exercise	$1\frac{1}{4}$–$1\frac{1}{2}$
Active exercise	$1\frac{3}{4}$–2
Severe exercise	3 or more

As preparation of estimating your Calorie expenditure, record your activities for two or three days, together with the time spent at each. Use the two left hand columns below, adding any other activities that are not included in the list. Then estimate and record in the third column (b) the number of Calories per hour that a person of your age and weight normally would expend at those activities. You can then complete the table.

Activity	a Hours spent	b Calories per pound per hour	c Your weight	Calories used daily (a×b×c)
Sleeping				
Dressing and undressing				
Sitting at rest				
Typewriting				
Studying				
Light exercise				
Severe exercise				

Total requirement _____

How does your total Calorie requirement compare with the standard usually indicated for a boy or girl of your age? _____

(Girls 14–17 years.....2200–2600 Calories per day)
(Boys 14–17 years.....2800–4000 Calories per day)

4. It is obvious that the food we eat must supply enough Calories of energy to meet our needs. Check up on your present average daily food supply to see if, from the standpoint of Calories, it has been adequate. Use the table on page 327 of BIOLOGY FOR BETTER LIVING or some other good reference for determining the Calorie value of your food.

Food item	Quantity or size of portion	Calories	Food item	Quantity or size of portion	Calories
Breakfast:			Breakfast:		
Lunch:			Lunch:		
Dinner:			Dinner:		
Total _____			Total		

How does your energy expenditure as calculated on page 119 compare with the energy value of the food you actually eat? _____

5. The calorimeter makes it possible to determine the *metabolic rate*, that is, the number of Calories released per hour, during different kinds of activities. Tables have been made showing these rates, at different ages, for human beings. What is the value of such tables? _____

_____

Name _____ Date _____ Class _____

6. Your judgment of the adequacy of your diet should take into consideration the *sources* of Calories as well as the Calorie content. Why? _____
The following exercises will help you to evaluate your diet from the standpoint of sources.

(1) Proteins
What chemical elements are in proteins? _____

_____

Can the human body change proteins into carbohydrates? _____

In what form are nitrogenous foods usable by animal cells? _____

_____

Why is it more difficult to get *energy* from protein foods than from carbohydrates?

_____

_____

_____

Why does an adult doing hard work not require more meat than an adult doing light work? _____

_____

_____

_____

(2) Carbohydrates and Fats
In what form are carbohydrates *used* in the body? _____

_____

What is the form in which *excess* carbohydrates are stored in the tissues? _____

_____

Can fats be changed into glucose or animal starch? _____

(3) Calorie content
Per gram of weight, approximately how many Calories are available in carbohydrates? _____ In fats? _____ In proteins? _____
What does this indicate with reference to "best" choice for energy foods? _____

_____

_____

(4) Obtain from a local grocery the present prices *per pound* of the following foods and figure the cost per hundred Calories for each.

Foods	a Cost per pound	b Number of Calories per pound	c Cost per 100-Calorie portion (a/b×100)
High in Protein Roast beef			
Hamburger			
Lamb chops			
Mackerel			
High in Fats Butter			
Olive oil			
High in Carbohydrates Potatoes			
String beans			
White bread			
Corn on cob			

What conclusions do you draw from the evidence in the above chart?

7. A number of the minerals are known to be essential to normal health. Since the necessary minerals are obtained through foods we eat, they form a part of our nutrition problem. Summarize information about minerals called for in the chart below.

Minerals	Common sources of each mineral	Value of the mineral to the body
Common salt (Sodium and chlorine)		
Potassium		
Sulfur		
Phosphorus		
Iron		
Iodine		

Name _____ Date _____ Class _____

8. What is meant by a balanced diet? _____

_____

_____

9. On the basis of what you now know about diet requirements for normal good health, plan a menu which would supply your energy, mineral, and vitamin needs for one day (or longer, if you wish). Use the space at the right to criticize your menu after it has been presented to the class for evaluation.

Food	Number of Calories	Criticism
Breakfast		
Lunch		
Dinner		

10. There has been a good deal of advertising of late concerning methods and techniques for dieting. In terms of metabolic rate, what would have to be true of the food intake in order for a person to reduce? _____

_____

_____

_____

_____

_____

11. State briefly how effective you believe the following "reducing methods" to be. Indicate also what dangers might be involved in each method.

(1) Doing more muscular work than usual _____

_____

Danger: _____

(2) Reducing amount of food but working just as hard _____

_____

Danger: _____

(3) Taking salts or other laxatives _____

_____

Danger: _____

(4) Bathing in special "reducing salts" _____

_____

Danger: _____

(5) Taking steam baths _____

_____

Danger: _____

(6) Taking thyroid extract _____

_____

Danger: _____

12. What are some of the problems that arise from lack of money to buy sufficient food?

_____

_____

_____

13. Boys and girls in high school seldom plan their own meals. What suggestions do you have for making your knowledge of balanced meals immediately useful to you?

_____

_____

Name _____ Date _____ Class _____

14. A food fallacy is a statement about the use of foods which has been proved false. Example: *Fish and milk eaten together are poison.* List as many food fallacies as you can.

_____

_____

_____

_____

IV. TESTING

1. As metabolism goes on in the body, many products are formed from the foods introduced. Sometimes the product formed may be changed more than once, as with proteins which are digested to amino acids and then are built into the cells again as proteins. In the following list, the arrow represents a *possible* change from the first to the second. If the change *does occur*, write "yes" and tell where the change may occur. If the change does not occur, write "no." Use any available references in taking this test.

Reaction or possible change	Can this occur in body? (Yes, No)	If so, where?
Proteins→Carbohydrates		
Carbohydrates→Proteins		
Fats→Proteins		
Fats→Carbohydrates		
Carbohydrates→Fats		
Carbohydrates→Energy		
Fats→Energy		
Proteins→Energy		
Energy→Carbohydrates		
Proteins→Amino Acids		
Amino Acids→Proteins		
Proteins→Protoplasm		
Carbohydrates→Nitrogen Wastes		
Proteins→Nitrogenous Wastes		

2. The following statements are to be marked *T* if they are true statements and *F* if they are false.

____ (1) The rate of metabolism is greater when one is sleeping than when awake.
____ (2) A calorie is a unit of heat energy.
____ (3) Proteins constitute the chief food necessary for repair of body tissues.
____ (4) Minerals are widely distributed in foods.
____ (5) A deficient supply of iron in the body is usually the cause of goiter.
____ (6) Carbohydrate foods are changed by digestion to glucose which is burned in the body, releasing energy.
____ (7) A growing boy needs more Calories *per pound of weight* than an adult.
____ (8) The most important bone-building mineral is calcium.
____ (9) Vitamins are good energy-producing foods.
____ (10) A person who needs to lose weight should follow a carefully prescribed diet.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State at least four generalizations which you know would apply with regard to planning a diet.

Name _____ Date _____ Class _____

Chapter 18: How Are Wastes Removed from the Body?

When fuels are burned in the cells of the body, certain waste materials are released. Carbon dioxide, a gas about which you have read, is one of these waste materials. Nitrogenous wastes result when body tissues are torn down and repaired. All these wastes must be released from the body. Just how is this done? That and related questions will be answered in this chapter.

I. DRAWING ON WHAT YOU ALREADY KNOW

Consider each of the following questions carefully. Then answer each to the best of your present ability. Space will be provided in Section V for you to modify or correct these answers.

1. What job is accomplished by our kidneys? _____

2. What waste products are eliminated from the body, in part, by perspiration? _____

3. Why might it be said that materials eliminated by bowel movements have never really been *inside* the body? _____

4. Are there any animals which do not use kidneys for removing wastes from their bodies? _____ If so, give examples of such animals. _____

5. How are waste materials removed from growing plants? _____

6. What other questions concerned with the removal of wastes from the bodies of plants or animals do you wish to have answered?

II. EXPLORING

Sherman, Henry C. *Chemistry of Food and Nutrition*. New York: The Macmillan Company, 1941. Contains an excellent discussion of the chemistry of body wastes.

Aaron, Harold. *Good Health and Bad Medicine*. New York: Consumers Union of United States, Inc., 1940. See Chapter XXXII for a discussion and evaluation of products sold for the care of the skin and its disorders.

Phillips, M. C. *Skin Deep*. New York: The Vanguard Press, 1934. Deals with the relation of cosmetics to the skin and gives suggestions for buying cosmetics.

Buchsbaum, Ralph. *Animals Without Backbones*. Chicago: The University of Chicago Press, 1938. Descriptions of the excretory organs of many kinds of invertebrates. Excellent illustrations.

Fishbein, Morris. *Your Diet and Your Health*. New York: Whittlesey House, McGraw-Hill Book Company, 1937. Includes a valuable discussion of the relation of diet to proper, normal elimination.

Elwyn, Adolph. *The Story of the Human Body*. New York: Grosset & Dunlap, 1934. Contains a simple and effective discussion of the ways by which wastes are eliminated from the body.

III. DOING AND RECORDING

1. The solid wastes from the digestive tract differ in character and origin from the liquid and gaseous wastes which are liberated from the cells of the body. It might be said that the solid wastes really never have been *inside* the body. Explain. _____

_____

_____

What types of materials make up most of the feces (solid wastes)? _____

_____

Why is it necessary that the feces be removed regularly from the body? _____

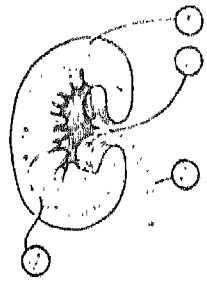
_____

2. By filling in the blanks in the following exercise you will be reviewing briefly the origin of nitrogenous wastes in the body.

Amino acids are carried by the blood from the intestines to a large organ, the _____, where the amino acids are stripped of their _____ if these acids are not immediately needed for cell growth and maintenance. This liberated _____ containing part of the amino acids is then changed into urea which is immediately carried to the _____. The amino acids which are needed for cell growth and repair are carried to the cells of the body and are deposited as proteins. When the proteins are used in cell building and repair, nitrogenous wastes are liberated which are collected by the _____ and carried to the _____ where the wastes are dissolved in water in the form of _____.

Name _____ Date _____ Class _____

3. How is the kidney built to perform its function? Examine the cross section drawing of the kidney shown here and identify the cortex, tubules, renal artery, and ureter by inserting the correct number in the parentheses before the name of each part. Then tell the function of each part.



( ) Cortex: _____

( ) Tubules: _____

( ) Renal artery: _____

( ) Ureter: _____

4. Which blood vessels carry the blood *from* the kidneys? _____

Which blood vessels carry the blood *to* the kidneys? _____

5. Why is it possible to overwork the kidneys by eating a diet high in protein content?

_____

6. How does the skin serve in eliminating liquid wastes? _____

_____

Name the functions of the sweat glands. _____

_____ What is the chief function? _____

7. How is carbon dioxide formed in the body? _____

_____

How is carbon dioxide removed from the body? _____

_____

8. Describe briefly the excretory organs and excretory process in each of the following.

(1) An insect: _____

_____

_____

(2) A frog: _____

_____

_____

IV. TESTING

Place a *T* before each statement that is true; an *F* before each statement that is false.

____ Except for water, the materials which are excreted by the kidneys always come from within the cells of the body.
____ The skin serves as an organ of excretion.
____ Carbon dioxide wastes are liberated through the kidneys.
____ Urea is a nitrogenous waste which is carried to the kidneys from the liver without leaving the blood stream.
____ All animals possess kidneys by which they excrete liquid wastes.
____ Much of the liquid waste of the body is temporarily stored in the bladder.
____ The lungs liberate a considerable amount of water from the body.
____ Most of the nitrogen which is liberated from the body has been taken into the body by eating protein foods.
____ By eating more protein foods than are necessary for normal growth and repair of body tissue, it is possible to overtax the kidneys.
____ Most people drink more water than is easily eliminated by the kidneys.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer the questions which you yourself raised in Section I?

3. Make at least four generalizations about the processes of excretion which seem to summarize the most important information concerning them.

Name _____ Date _____ Class _____

UNIT IV. PLANT AND ANIMAL BEHAVIOR

Chapter 19: How Do Living Things Become Aware of Their Surroundings?

Certain parts of your body are adapted for keeping you in touch with the world around you. If you shut your eyes, the light is shut out. If you plug up your ears, sound is shut out. Your nose helps in detecting odors. Eyes, ears, and nose are three of your sense organs. The ways in which they operate make a most amazing story. In order to keep them healthy it is important to know that story.

I. DRAWING ON WHAT YOU ALREADY KNOW

Read each of the following questions carefully. Indicate those questions which you think you could answer *now* by writing *M* on the blank after them. Indicate with an *L* those about which you now know *little*. Place *O* after those about which you now know *nothing*.

1. How is the human eye made? _____
2. How is the eye like a camera? _____
3. What causes farsightedness? _____
4. What causes nearsightedness? _____
5. What good does it do to wear glasses? _____
6. How can astigmatism be corrected? _____
7. Can any animal which does not have eyes see? _____
8. How is it possible for animals to react to light if they do not have eyes? _____
9. Why do dogs sometimes prick up their ears when you hear nothing at all? _____
10. How is the human ear built? _____
11. What is the difference between tasting and smelling? _____
12. How does a person keep his balance? _____
13. List any other questions concerned with the structure or function of sense organs that you wish to have answered.

_____

_____

_____

_____

14. As a tentative generalization it might be stated: *Persons become farsighted as they grow older, and need to wear glasses to correct the difficulty.*

    What is your hypothesis (best guess) as to the reason for farsightedness in many old persons? _____

    _____

    _____

II. EXPLORING

Oaks, L. W., and Merrill, H. G. *Your Nose, Throat and Eyes.* New York: D. Appleton-Century Company, Inc., 1929. A book dealing with the structure, health, and care of the sense organs.

Thompson, Edgar S. *Your Eyes and Their Care.* New York: D. Appleton-Century Company, Inc., 1929. Contains suggestions for treating simple eye injuries.

Ross, Martin. *Your Tonsils and Adenoids.* New York: D. Appleton-Century Company, Inc., 1926. What tonsils are and how to take care of them, with emphasis on their relation to disease.

Carlson, A. J., and Johnson, Victor. *The Machinery of the Body.* Chicago: the University of Chicago Press, 1941. Vision and the eye—Chapter XI, p. 445; Hearing and the ear - Chapter XI, p. 460; Balancing the body—Chapter XI, p. 465; Taste and smell - Chapter XI, pp. 471-474.

Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran & Company, 1934. Sensations and the senses are described. See pages 110–133.

Henderson, Olive G., and Rowell, Hugh G. *Good Eyes for Life.* New York: D. Appleton-Century Company, Inc., 1933. An excellent little book written for those who wish eye happiness,

Edman, Irwin. *Arts and the Man.* New York: W. W. Norton & Company, Inc., 1939. This delightful book discusses (Part IV) the relation of color and vision to plastic arts, and (Part V) the relation of sound and the ears to music.

III. DOING AND RECORDING

1. Use a magnifying glass or other convex lens for the following experiments which are designed to help you better understand how the lens of the eye works.

   (1) Hold the lens about a foot in front of a piece of stiff paper, with the glass toward a window. Move the glass back and forth until a clear *image* of the window appears on the paper. Describe the size and position of the image. What is the focal length, that is, the distance of the lens from the paper? _____

   _____

   (2) The above demonstration illustrates the action of the lens of the eye in forming a clear picture on the retina of the eye. Now, keeping the lens at the focal length recorded in (1), walk slowly toward the window. What happens to the image? _____. Unlike the lens of the eye, the glass lens cannot be thickened. Therefore the image becomes blurred. Sometimes in human beings the lens of the eye hardens so that it cannot change its shape sufficiently to form clear images. In such cases glasses are worn to correct lack of thickness or too great thickness of the eye's lens.

   (3) Again keeping the lens at the focal length recorded in (1), walk away from the window. What happens to the image? _____

   (4) Repeat number (1) until a clear image of the window again forms on the paper. Now move the paper toward the lens. What happens? _____ Move the paper away from the lens. What happens? _____ Sometimes, the eyeball is too long or too short for a clear focus to be formed when the eye is viewing objects at certain distances. In such cases blurred images result. Corrective lenses in eyeglasses will help to overcome this handicap.

Name _____ Date _____ Class _____

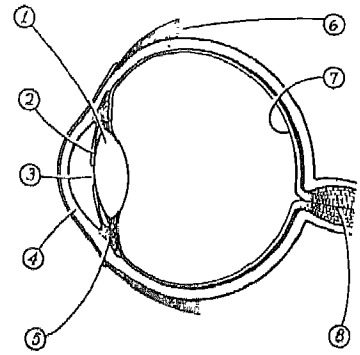
2. Have a classmate sit facing the window while you sit facing your classmate. Look into his eyes, observing carefully the size of the pupils. Then have him close his eyes for half a minute or more. When he opens them, still facing the window, watch closely the pupil in one of his eyes. Describe what happens. _____

_____

3. Hold your pencil at arm's length in front of your eyes. Alternately open and close your right and left eyes. What appears to happen to the pencil? _____

How do you explain your observations? _____

4. We are able to see objects because of the light which comes from them to our eyes. Therefore the eyes must be made in such a way that light may pass into them. After studying drawings or charts of the eye, identify the parts which are indicated in the drawing by writing their names after the corresponding numbers below. Then fill in the rest of the information called for.



Parts of the eye	Function of each part
(1) _____	_____
(2) _____	_____
(3) _____	_____
(4) _____	_____
(5) _____	_____
(6) _____	_____
(7) _____	_____
(8) _____	_____

5. Make a study of color blindness. Summarize your findings, including answers to the following questions. Attach your summary to this page.
   (1) What colors can color-blind people see?
   (2) Are there several kinds of color blindness? Describe.
   (3) What is a test for color blindness?
   (4) What are the disadvantages of being color-blind?

6. Describe how each of the following animals reacts to light.

Housefly: _____

Crayfish: _____

Starfish: _____

Amoeba: _____

7. Complete the following table by telling briefly the function of each part of the ear listed.

Drum: _____

_____

Hammer, Anvil, Stirrup: _____

_____

Cochlea, Semicircular canal: _____

_____

Auditory nerve: _____

_____

Eustachian tube: _____

_____

8. Use a physics book or some other reference to learn the number of vibrations per second of each of the following pitches or piano notes.

Pitch	Number of Vibrations
Middle C	
C below middle C	
C below C below middle C	

Why are there not two more octaves on the bass end of the piano? _____

_____

9. What evidence can you give to show that some animals can hear sounds which man cannot hear? _____

_____

_____

Name _____ Date _____ Class _____

10. Use as "taster" a classmate who is blindfolded and prevented from smelling by having his nostrils closed. Place on his tongue a small portion of each of the substances listed. Record his reactions to each by placing checks or writing in the spaces below.

Substances	Tastes sour	Tastes sweet	Tastes bitter	Tastes salty	No taste	Undecided	Other taste
Salt water							
Vanilla extract							
Lemon juice							
Pepper							
Sugar							
Maple flavor							
Cod liver oil							
Baking soda							
Onion							
Mustard							

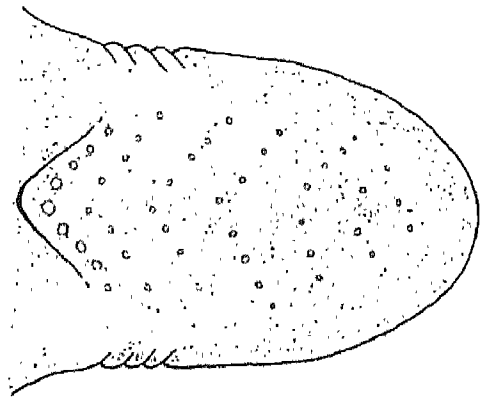
What substances, or "flavors," can be tasted? _____

_____

Conclusions: _____

_____

11. Determine how taste buds are distributed on the tongue by placing something sour at various places on it. Obtain sufficient evidence to conclude which part of the tongue can taste sour most easily. Then write *sour* on that part of the picture of the tongue. Do the same to determine which parts of the tongue most easily detect sweet, bitter, and salty tastes.



Conclusions: _____

_____

_____

12. To determine which parts of the body are most sensitive, blindfold one member of the class and then lightly touch the two points of a drawing compass or of a hairpin on the back of the hand. Begin with the points about two inches apart, and decrease the distance gradually. Each time ask if one or two points were felt. Measure distance apart when the blindfolded person first says he was touched by only one point. Vary the procedure by testing other parts of body. Record results in the spaces provided in the table.

Region of body	Distance between points when only one point is felt				
	First Pupil	Second Pupil	Third Pupil	Fourth Pupil	Remarks
Back of hand					
Finger tips					
Lips					
Back of neck					
Upper arm					
Back					
Forehead					

What conclusions do you draw about the distribution of the organs of touch over the body? _____

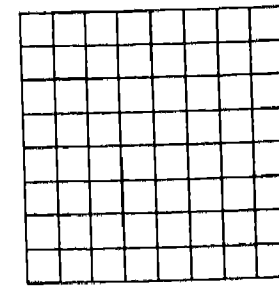
_____

_____

13. An interesting experiment to show sensitivity to heat, pain, and cold may be made as follows. Plot out an area an inch square on the back of your hand and draw lines an eighth of an inch apart to make 64 small squares within the inch square.

(1) Sensitivity to cold

Start at one corner of the square marked on your hand, using a hairpin which has been pressed against a piece of ice. Touch lightly but firmly each square. Be sure to hold hairpin against ice between each trial on the hand so that the tip will always be cold. Work methodically. You will note that a distinct sensation of cold is felt in some of the tiny squares, and none in others. Mark with a small x each area in the square to the right that corresponds to a sensitive area on the hand.

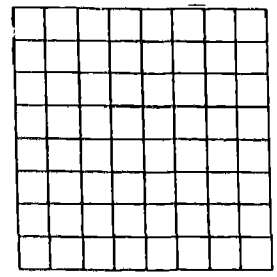


Name _____ Date _____ Class _____

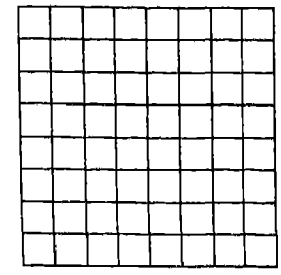
(2) Sensitivity to heat

Repeat the experiment, using a hairpin which has been dipped in hot water between each trial. Mark each sensitive area in the corresponding area in the square at the right.

Heat



Pain



(3) Sensitivity to pain

Repeat the experiment, using a pin. Take care not to puncture the skin. Touch lightly, but firmly and record results as in preceding experiments.

Summarize findings, telling what the above experiment demonstrates and whether or not the same nerve endings were sensitive in each case. State any conclusions that you draw. _____

_____

IV. TESTING

1. One word in each of these groups is not directly related to the other three. Draw a circle around this unrelated word in each group.

(1)	pupil	retina	cochlea	lens
(2)	hammer	anvil	stirrup	astigmatism
(3)	shallow eyeball	thin lens	thick lens	farsightedness
(4)	astigmatism	farsightedness	cataract	nearsightedness
(5)	tongue	sight	hearing	smell
(6)	sweet	pain	sour	bitter
(7)	cochlea	Eustachian tube	eardrum	optic nerve
(8)	ciliary muscle	hearing	focusing	accommodation
(9)	taste buds	papillae	tongue	salty
(10)	nearsightedness	shallow eyeball	thick lens	long eyeball

2. Encircle the ending which in each case correctly completes the incomplete statement.

(1) In order for a substance to be smelled, it must be in the form of a
gas liquid solid papilla

(2) A structure which helps keep air pressure in the middle ear equal to air pressure outside is called the
nasal passage semicircular canal Eustachian tube cornea

(3) An animal which has its ear drum on its abdomen is the
frog grasshopper amoeba spider

(4) The region in the eye at which the optic nerve enters the eyeball is known as the
iris blind spot pupil lens

(5) A person who is nearsighted could have his vision corrected by wearing glasses with properly fitted
concave lens convex lens astigmatic lens double convex lens

(6) If his nose were closed, a person could distinctly *taste*
cod liver oil sugar vanilla extract onion

(7) It is known that most persons cannot hear sounds with a vibration frequency greater than
16 per second 12,000 per minute 16,000 per second 30,000 per second

(8) The organ for the sense of balance in man is the
semicircular canal olfactory lobe auditory canal retina

V. SUMMARIZING

1. How now would you answer those questions in Section I about which you indicated that you knew little or nothing?

2. Reread the explanation which you wrote in Section I regarding farsightedness in older persons. If it needs correction, use this space to write the correct explanation.

3. How now would you answer the questions which you yourself raised in Section I?

4. State several precautions or rules for the care and use of ears, eyes, nose, and other sense organs.

Name _____ Date _____ Class _____

Chapter 20: The Nervous Control of Behavior

We have learned that certain sense organs help the organism to interpret its surroundings, but little has been said about how organisms decide what to do if their surroundings prove uncomfortable and in need of change. Some animals *change* their environment. Others must *adapt* themselves to it, or die. How are living things organized so that they can react to their surroundings? This is the major question which this chapter will help you to answer.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Do *all* animals have a nervous system? _____

2. How do plants react or adjust themselves to their environment? _____

_____

_____

3. As organisms are developed with a larger and larger number of special parts, do their nervous systems become more and more highly developed? _____ Explain.

_____

_____

_____

_____

4. What are the main parts of the nervous system of man? _____

_____

_____

5. Could a person live if part of his brain were destroyed? _____ Tell why you answer as you do. _____

_____

_____

6. What is phrenology? _____

_____ Is it widely practiced today? _____

7. A great deal of controversy has existed among persons who have made a study of human behavior in an attempt to learn *what intelligence really is*. Do you have a notion or hypothesis as to the answer? State your idea here. _____

_____

_____

_____

8. What other questions concerned with the nervous control of living things would you like to have answered?

_____

_____

_____

_____

II. EXPLORING

Buchsbaum, Ralph. *Animals Without Backbones*. Chicago: The University of Chicago Press, 1938. A study of simple animals like the ones described helps to explain the behavior of higher animals.

Carlson, A. J., and Johnson, Victor. *The Machinery of the Body*. Chicago: The University of Chicago Press, 1937. How the brain and nerves work in man: Chapter IX, "The Action of Muscle and Nerve." Chapter X, "The Spinal Cord and the Brain."

Köhler, Wolfgang. *The Mentality of Apes*. New York: Harcourt, Brace and Company, 1925. A description of experiments showing ape mentality.

Yerkes, Robert M. *Almost Human*. New York: D. Appleton-Century Company, Inc., 1925. Interesting studies of animals, intended to help us understand human relations and activities.

Huxley, Julian S., and Andrade, E. N. *Simple Science*. New York: Harper & Brothers, 1935. Chapter III describes in a very clear manner how the nervous system controls the body.

Clendening, Logan. *The Human Body*. New York: Alfred A. Knopf, 1928. Part I, Chapters X and XI, explains the way the nervous system controls behavior.

Elwyn, Adolph. *The Story of the Human Body*. New York: Grosset & Dunlap, 1934. An unusually good account of the way "The Central Government" (our nerves) works. See Chapters XIII and XIV.

III. DOING AND RECORDING

1. In which direction does the stem of a plant normally grow? _____ How could you prove this? _____

_____

2. What behavior does the blossom of a sunflower display on a sunny day? _____

_____

3. Is wilting ever beneficial to plants? _____ If so, why? _____

_____

Name _____ Date _____ Class _____

4. Simple reactions of plants, such as the behavior of sunflower blossoms, are called *tropisms*. Is there evidence which tends to show that plants *think* before they react? _____
What evidence supports your answer? _____

5. Describe how the two animals listed below, and one other invertebrate animal of your own choice, control their behavior. Indicate briefly how the nervous system of each (if it has one) is constructed to permit control of behavior.

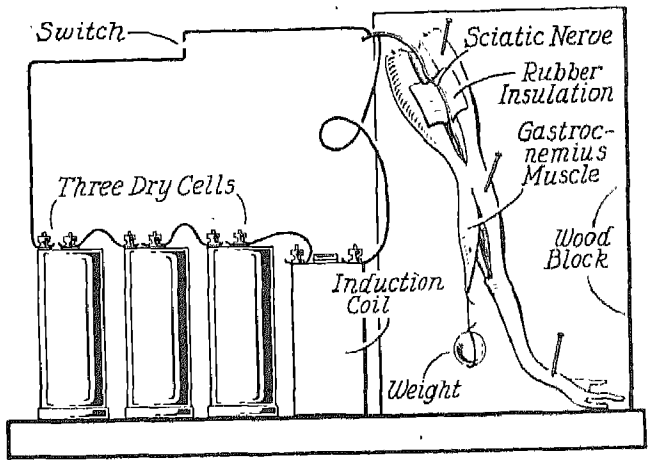
Paramecium: _____

Grasshopper: _____

Your choice of invertebrate animal: _____

6. Dissect out the brain and top part of the spinal cord of a frog and of a mammal. A rat or a cat may be used for the latter.
   (1) Frog: Remove the skin on the dorsal surface of the frog and, using scissors, carefully cut away enough of the vertebrae to expose the spinal cord. Remove also the roof of the skull exposing the brain. Locate the different parts of the brain. Use space opposite to show their position and relative size by means of a sketch.
   (2) Cat or rat: Remove the skull from around the brain and study the parts. Compare the size and arrangement of the parts with those of the frog. Record observations below.

7. To prepare a muscle-nerve preparation in a frog or a toad, kill the animal with chloroform. Cut the upper two thirds of the trunk from the legs, leaving only the pelvis and the hind legs. Split the pelvis in two lengthwise. Each of the two halves may be used by different students. In the thigh of the leg, find the sciatic nerve. This nerve will be found, together with the femoral artery and vein, under a narrow band-like muscle. See drawing. Push aside the muscle or cut it away, exposing the nerve—a white strand. Free the nerve with a pencil point and slip a small sheet of rubber under it to insulate it.



The preparation is now ready for stimulation. You may wish to mount it on a board, as shown in the drawing. Cut the tendon of the gastrocnemius muscle loose at the lower end, leaving as much of the tendon attached as possible. Attach a light weight to the tendon by means of a crooked pin and a thread. *Be sure to keep the nerve and muscle constantly moist with a weak, warm salt solution.*

Stimulate the nerve ending by means of an electric current from three dry cells and an induction coil as shown in the figure. An old Ford coil will do. Observe the muscle reaction the instant the switch is *closed* and *opened*. Describe what happens. _____

_____

_____

_____

8. To observe reflex action, use a frog. Cut off its head and lay the animal on a table. Stretch out a leg. What is its position? _____

Now apply a drop of 10 per cent acetic acid to the hind foot. What happens? _____

Apply the acid to the chest. What happens? _____

Apply the acid to the side. What happens? _____

Now destroy the spinal cord also by pithing it. Repeat the experiments performed above. What are the results this time? _____

Explain. _____

9. To determine the reaction time of a group of students, have ten or more of them, including the teacher, join hands to form a circle, and close their eyes. The teacher starts a signal by pressing the hand of the pupil to her left. At the same instant she starts a stop watch held in her right hand. When the pressure signal has passed from hand to hand around the group and reaches the teacher's right hand, the stop watch should be instantly stopped. Average individual reaction can be found by dividing the total time by the number in the group.

Total time _____ Average individual reaction _____

Name _____ Date _____ Class _____

What happened to each individual's nervous system during this experiment? _____

_____

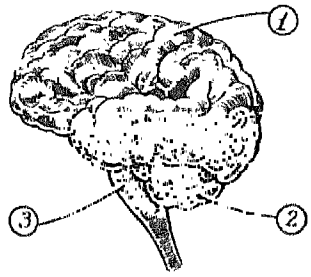
_____

10. From your knowledge of the results when parts are cut off various organisms, such as live sponges, earthworms, frogs, and human beings, what conclusions can you state about the relationships between ability to develop new parts and the complexity of an organism? _____

_____

11. In the space below sketch the essential parts of the nervous system. Label them and indicate which part is the *central nervous system*. Place a check (√) by each part which is concerned with voluntary behavior.

12. Identify the three parts of the brain shown in the diagram. Then tell the function of each.



	Part of brain	Function
(1)	_____	_____
		_____
(2)	_____	_____
		_____
(3)	_____	_____
		_____

13. Define or explain each of the following words or phrases.

Gray matter: _____

Neuron: _____

Afferent nerve: _____

Efferent nerve: _____

Cranium: _____

Ganglion: _____

14. From the list of animals given in the left-hand column of the following table, select the five that, in your opinion, are the most intelligent. Place numbers (1 to 5) in the second column to indicate your opinion. From the data in the third and fourth columns, figure the ratio of brain weight to body weight, thus: $\frac{\text{Brain weight}}{\text{Body weight}} = \text{Ratio.}$

For example, for the sheep, $\frac{130}{50,000} = 0.0026$, or $1/385$.

Animal	Comparative intelligence	Approximate Brain weight (grams)	Approximate Body weight (grams)	Ratio of brain weight to body weight
Mouse		0.4	20	
Squirrel		6	400	
Cat		30	3,500	
Monkey (macaque)		100	5,000	
Dog (large)		120	46,000	
Sheep		130	50,000	
Bear		400	200,000	
Gorilla		400	90,000	
Cow		450	175,000	
Hippopotamus		580	1,750,000	
Horse		600	300,000	
Man		1,400	70,000	
Elephant		5,000	2,500,000	
Whale		7,000	70,000,000	

Name _____ Date _____ Class _____

After studying your completed chart, answer the following questions:

(1) Does man possess the heaviest brain of these animals? _____

(2) What animal has the heaviest brain? _____

(3) Does the heaviest brain indicate the greatest intelligence? _____

(4) In general, is the relative size of the brain larger among small animals or among large animals? _____

(5) In which animals is the relative brain weight to body weight as large as or larger than in man? _____

(6) Which three animals did you indicate were the most intelligent?

_____

(7) Do all three of the animals you listed in your answer to Question 6 have the largest relative brain weights? _____

(8) Can you conclude that the relatively larger brains (compared with body weight) indicate a greater degree of intelligence among the various animals? _____

IV. TESTING

1. Place *T* in front of each statement which, in your judgment, is correct. Place *F* in front of each incorrect one.

(1) All animals have a distinct nervous system.

(2) Since plants do not have a nervous system, they cannot react to their environment.

(3) The cerebellum is important because it helps maintain balance.

(4) Efferent nerve fibers carry nervous impulses to the brain.

(5) The motor impulses are responsible for causing some muscle or organ to act.

(6) It is known that big bumps on the back of a person's head mean that he is a loving person.

(7) After the cerebrum of a frog has been removed, the frog no longer can jump.

(8) Bundles of nerve cells and their connections are called *ganglia*.

(9) The autonomic nervous system is the same as the central nervous system.

(10) Voluntary action is controlled by the central nervous system.

2. Which of your activities are controlled principally by your cerebrum? _____

_____

By your cerebellum? _____

_____

By your medulla? _____

_____

By your spinal cord? _____

_____

3. Can a human being ever behave intelligently without thinking? _____ Explain.

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. Reread the hypothesis by which you attempted to explain what intelligence really is. How now would you modify that hypothesis?

3. How would you now answer those questions which you yourself raised in Section I?

4. What are some of the conclusions or generalizations which you can make about the nervous system in man or in other animals?

Name _____ Date _____ Class _____

Chapter 21: Involuntary Control of Behavior

In Chapter 20 nothing was said about the control of the heart, of the process of breathing, of digestion, or of other behaviors classed as *involuntary*. How is involuntary behavior controlled? That question will be considered in this chapter.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. What is meant by involuntary behavior? _____

2. Can a person hold his breath long enough to suffocate himself? _____ Explain. _____

3. Does the growth of a simple goiter have any relation to involuntary behavior? _____ If so, what? _____

4. Why does a person sometimes feel weak in the knees after a severe fright? _____

5. What causes stunted growth, as in dwarfs or midgets? _____

6. How do vitamins play a part in the control of behavior? _____

7. What causes "goose pimples" when you are cold or frightened? _____

8. What other questions concerned with involuntary behavior do you wish to have answered?

II. EXPLORING

Keliher, Alice. *Life and Growth.* New York: D. Appleton-Century Company, Inc., 1941. See Chapter VII for an effective account of the autonomic nervous system and the ductless glands.

Carlson, A. J., and Johnson, Victor. *The Machinery of the Body.* For a concise treatment of the glands of internal secretion, see Chapter XII. The vitamins are discussed in Chapter VIII; autonomic nerves, Chapter IX.

Clendening, Logan. *The Human Body.* New York: Alfred A. Knopf, 1928. For the place of the ductless glands in coordination and control of the body, see Part II, Chapter IX.

Hoskins, R. G. *The Tides of Life.* New York: W. W. Norton & Company, Inc., 1933. An excellent discussion of *hormones*—where they come from, where they go, and what they do.

Borsook, Henry. *Vitamins.* New York: The Viking Press, 1941. Discusses the vitamins—what they are and how they benefit you.

Dietz, David. *Medical Magic.* New York: Dodd, Mead and Company, 1938. Part V, "The Magic of Glands," gives an interesting account of how the ductless glands function.

Sure, B. *The Little Things in Life.* New York: D. Appleton-Century Company, Inc., 1937. A presentation of the vitamins, hormones, and other minute essentials for health.

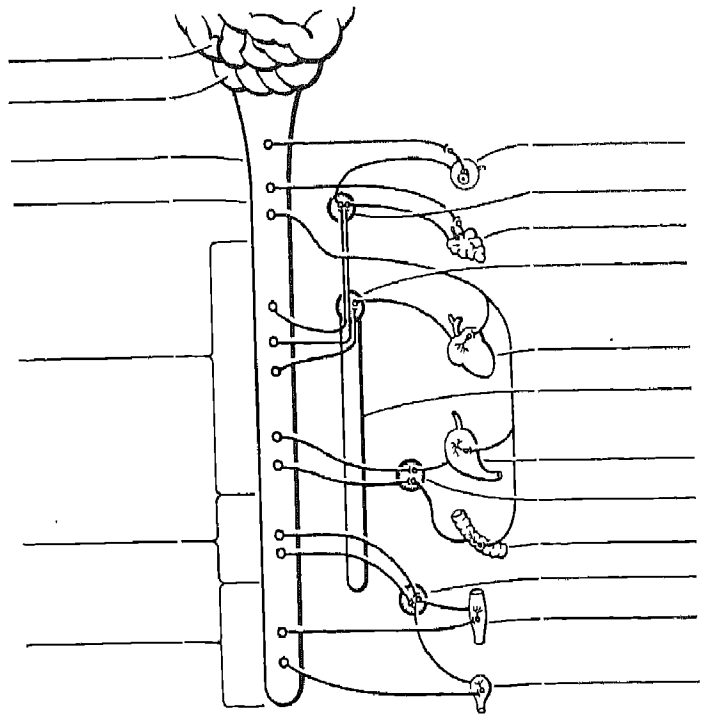
III. DOING AND RECORDING

1. List several involuntary body processes. If there are definite muscles involved in carrying out any of the processes which you list, write in the parentheses the kind of muscles they are.

_____ ( ) _____ ( )

_____ ( ) _____ ( )

2. To clarify your thinking about the part of the nervous system which controls the involuntary actions, study the accompanying diagram. Then label the parts indicated. As you label each part, find out if it is controlled by a nerve which *inhibits* its action and by a nerve which *augments* its action. What is meant by inhibit? _____



What is meant by augment?

Name _____ Date _____ Class _____

3. Kill a frog and quickly remove its heart. Place the heart immediately in a dish of lukewarm water to which a little salt has been added. What do you observe? _____

_____

4. Count the pulse under conditions indicated in the table. Use space provided to record pulse count in each case. Record data from three classmates also.

Person	Normal rate of heart	After mild exercise	After vigorous exercise
Myself			
Student A			
Student B			
Student C			

5. Select four or five students and observe normal coloration of hands. Then have each place his hands in a bowl of ice water for a minute or so. Again observe coloration. What change has taken place? _____

How do you account for your observations? _____

_____

6. In the space provided in the table, list characteristics which are associated with each of the two kinds of muscles.

Smooth muscles (Involuntary)	Striped muscles (Voluntary)

7. Which nerve speeds up the heart beat? _____

Which nerve slows it down? _____ Is there any nervous control *within* the heart itself? _____ Explain. _____

_____

_____

8. Obtain several tadpoles of the same size. Separate them into two groups. Into the water in which one group is living put small quantities of thyroxin. Watch both groups for several days. What do you observe? _____

_____

9. What are the *ductless* or *endocrine* glands? _____

_____

Complete this sentence by filling in the blanks.

The substances secreted by ductless glands are called _____ and are carried throughout the body by the _____

10. Fill the blanks in the following table with the information called for about hormones.

Hormone	Where produced	What it controls or regulates in the body	Maladjustment when there is too much	Maladjustment when there is too little
Thyroxin				
Parathyroxin				
Adrenalin				
Pituitary secretion				
Insulin				

11. If a person is slow to react to changes and is generally *lethargic*, what endocrine might be influencing his behavior, though *not necessarily so?* _____

If a person is extremely excitable and nervous, what hormone might be exerting abnormal influence? _____

Can persons always be blamed or praised for the particular kinds of behavior which they exhibit? _____ Defend your answer. _____

_____

_____

12. Conduct an experiment to determine the effect of vitamin deficiencies on the rat. Since this will take considerable time, careful planning is required. From General Biological Supply House, Chicago, secure a booklet called "Laboratory Experiments in Nutrition with Special Reference to the Laboratory Care of the White Rat." Conduct your experiment as suggested by this booklet. Summarize procedures and results, and attach them to this page.

Name _____ Date _____ Class _____

13. Recall what you learned in Chapter 17 about the sources of vitamins and their values to the body. Use the space provided in the table for summarizing briefly the characteristics of some diseases caused by vitamin deficiencies. Use the right hand column to indicate the names of persons who, through research, have made major contributions to our knowledge of the causes of each disease.

Disease	Description of the disease	How cured	Researcher
Scurvy			
Rickets			
Pellagra			
Night blindness			

14. Heating tends to destroy some vitamins. After reading references on the preparation of foods to preserve vitamin content, complete the following chart.

Vitamin	Good sources	Destroyed by heating		Recommended way of preparing vitamin source for eating
		Yes	No	
A				
B_1				
B_2				
C				
D				
E				

15. To protect yourself if you want to purchase vitamins in the form of concentrates (tablets or pills), you should know the meaning of *International Unit of Vitamin*. What does this term mean? _____

_____

16. Vitamins, hormones, and enzymes are alike in that they all are chemical substances. In what other ways are they alike? _____

_____

How do they differ? _____

17. Vitamin B_1 (thiamin) is of importance to the growth of plants. If you take two plants of the same kind and size and give small quantities of Vitamin B_1 to one of the plants and not to the other, you should see a distinct difference in their rates of growth. Try this over a period of several weeks. Then summarize briefly your observations

_____

_____

IV. TESTING

1. Place a check mark (√) before all endings which correctly complete each of these incomplete statements. You may need to check more than one ending in each group.

(1) The autonomic nervous system in man
- ____ controls all the *vital* processes.
- ____ is made up of pairs of nerves which leave the brain directly or leave the spinal cord.
- ____ controls the contraction of the pupils of the eyes.
- ____ has control over the striped or voluntary muscle fibers.

(2) The autonomic nervous system in man
- ____ has complete control of the action of the heart.
- ____ controls the flow of saliva in the mouth.
- ____ consists of the cerebrum and the medulla.
- ____ works only when the central nervous system is resting.
- ____ makes it impossible for him to avoid breathing after holding his breath for several minutes.

(3) Smooth or involuntary muscles in the body are
- ____ under the control of the central nervous system.
- ____ under the control of the spinal cord.
- ____ found in the stomach and intestines.
- ____ capable of acting and reacting more rapidly than do voluntary muscles.
- ____ controlled almost entirely by hormones.

(4) The human heart
- ____ is more nearly like striped muscle than like smooth muscle.
- ____ is speeded up and slowed down by stimuli coming through the involuntary nervous system.
- ____ has a regulating bundle of nerves within itself.
- ____ is one of several organs regulated by the vagus nerve.
- ____ would beat indefinitely if removed from the body.

(5) The hormones of the body are
- ____ used in rebuilding tissues.
- ____ conducted through the body by many small ducts.
- ____ produced by the endocrine glands.
- ____ always present in the proper amount.
- ____ carried to various parts of the body by the blood stream.

Name _____ Date _____ Class _____

(6) The hormone thyroxin is

____ produced by the larynx, commonly called the voice box.
____ used to regulate the rate of burning of food fuels in the body.
____ sometimes deficient in the body, thus bringing about a condition which causes simple goiter.
____ sometimes overabundant, thereby causing gigantism.
____ the same as parathormone.

(7) Adrenalin is a hormone which

____ is sometimes quite properly called the "emergency" hormone.
____ is formed in the pituitary gland.
____ can stimulate the liver to pour increased amounts of sugar into the blood.
____ seems to be able to speed up the action of the heart.
____ is known to be responsible for controlling calcium in the blood.

(8) Vitamin D is

____ sometimes called the "sunshine vitamin."
____ necessary to prevent the development of scurvy.
____ a vitamin which can be made *in* the human body.
____ sometimes deficient, thereby causing bone diseases.
____ made in the body when sunlight passes through window glass to the surface of the skin.

(9) The vitamins are particularly important to the body because

____ they can be used to supply energy to the body.
____ they promote chemical changes necessary in the body.
____ they take the place of hormones deficient in the body.
____ they prevent various diseases.
____ they are found in many common foods.

2. State two reasons why it is wise for young people to know about hormones. Then state two reasons why it is important to know about vitamins.

Hormones: (1) _____

_____

(2) _____

_____

Vitamins: (1) _____

_____

(2) _____

_____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State several generalizations or principles concerned with involuntary behavior of man, i.e., involving man's nervous system, hormones, or vitamins, which you believe to be important.

Name _____ Date _____ Class _____

Chapter 22: Interpreting and Predicting Living Behavior

Although we have considered voluntary and involuntary reactions, much remains to be explained before we can really interpret or predict behavior. What makes a person decide to act as he does? How does a person build patterns of habits? How much of one's attention is absorbed when tying shoe laces? Such questions are concerned with behavior. We will now consider various theories purporting to explain our behavior.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will be given opportunity to revise these answers.

1. Do you know of some kind of behavior which can be performed with no thinking on your part? _____ If so, what? _____

2. How does the act of going up or down stairs, as performed by a two-year-old child, differ in amount of thinking from amount of thinking when the same act is performed by you?

3. What do we mean when we say a person has *insight* into a problem? _____

4. What do you understand the phrase "stimulus-response theory of behavior" to mean?

5. How does a person *learn?* _____

6. What other questions concerned with interpreting and predicting behavior do you wish to have answered?

II. EXPLORING

Ealand, C. A. *Marvels of Animal Ingenuity.* Philadelphia: J. B. Lippincott Company, 1926. Interesting accounts of the curious habits and homes of many animals, including birds and insects.

Herrick, C. Judson. *The Thinking Machine.* Chicago: The University of Chicago Press, 1932. An excellent discussion of conditioned learning in man and in the lower animals is found in Chapter V.

Hingston, H. *Problems of Instinct and Intelligence.* New York: Macmillan Company, 1926. A fascinating account of the wisdom and folly of insects as suggested by their behavior.

Allee, W. C. *The Social Life of Animals.* New York: W. W. Norton & Company, Inc., 1938. Did you ever hear of the "peck order" in birds? It is only one of the kinds of animal "social orders" described in this book.

Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran and Company, 1934. For a discussion of instincts and emotions see Book VIII, pp. 1102–1435.

Yerkes, R. M., and Learned, W. B. *Chimpanzee Intelligence and Its Vocal Expression.* Baltimore: William & Wilkins, 1925. A remarkable study of the behavior of chimpanzees.

III. DOING AND RECORDING

1. A number of new words must be understood if you are to read and discuss the problem of behavior in a satisfactory way. Write good definitions for each of the following.

Motive: _____

_____

Insight: _____

_____

Goal: _____

_____

Stimulus: _____

_____

Response: _____

_____

Synapse: _____

_____

Instinctive behavior: _____

_____

Reflex arc: _____

_____

Name _____ Date _____ Class _____

2. After reading the following descriptive incident, tell what you believe to be the correct explanation of the dog's behavior.

   A small terrier chased a squirrel up a large tree in a park. At the foot of the tree, the dog barked about five times. Then it went some fifty feet away and lay down, keeping an eye on the tree. It did not bark again. After a while, the squirrel ventured down. Only when it had reached the ground and had begun to scamper toward another tree did the terrier move. Then, instead of running after the squirrel, the terrier ran for the same tree toward which the squirrel was running. The squirrel turned and ran back to the first tree. The dog ran out of the park.

   _____

   _____

   _____

   Now examine your explanation. Have you given the dog a motive? What was it? _____

   _____

   What were some of the environmental factors which according to your explanation were important in influencing the dog's behavior? _____

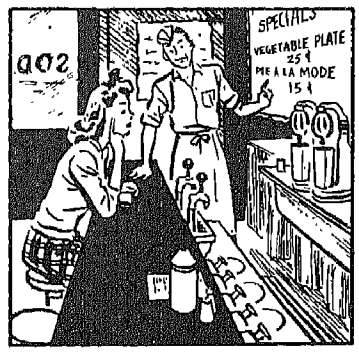
   _____

   In your explanation, did you indicate that the dog did some reasoning or had an insight? _____ If so explain why. _____

   _____

   _____

3. This drawing and three others at the top of page 158 indicate certain situations which require the making of decisions. Tell what decision must be made in each situation and what factors must be taken into account.



   Decision involved: _____

   _____

   _____

   Factors to take into consideration: _____

   _____

   _____

Decision involved: _____

_____

Factors to take into consideration: _____

_____

_____

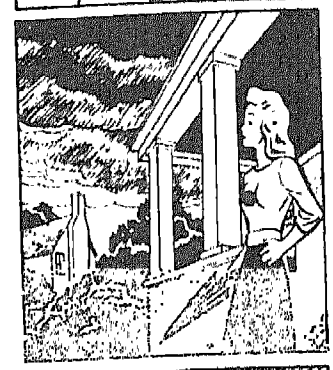
Decision involved: _____

_____

Factors to take into consideration: _____

_____

_____



Decision involved: _____

_____

Factors to take into consideration: _____

_____

_____

4. Give some examples of behaviors which usually have been explained as kinds of stimulus-response behaviors (1) in lower animals: _____

_____

(2) in man: _____

_____

5. According to the stimulus-response theory, what changes take place in the nervous system, and how does the nervous system play a part when learning takes place? _____

_____

_____

_____

_____

_____

Name _____ Date _____ Class _____

6. Make a drawing to illustrate the nervous connections in a *reflex arc*. Label the parts which you show in your drawing.

7. State briefly the difference between an *instinct* and a *habit*. Then, in the space indicated, list some animal behaviors which belong in each classification.

_____

_____

Instincts	Habits
_____	_____
_____	_____
_____	_____
_____	_____

8. As you sit with your knees crossed, have someone strike your unsupported leg just below the kneecap with the edge of the hand. Repeat the experiment several times. What happens? _____

   Is this habitual, instinctive, or reflexive behavior? _____

9. Have all the students in class fold their hands together tightly. Make a count to determine how many students have the left thumb over the right thumb and vice versa. Have the students unfold their hands and repeat the experiment. What are the results this time?

	First Trial	Second Trial
Number of left thumbs over right:	_____	_____
Number of right thumbs over left:	_____	_____

   Does each student always fold his hands the same way? _____ Is this a habit or an instinctive behavior? _____ Why do you think as you do? _____

_____

_____

10. Is the study of animal behavior of any value in better understanding the behavior of man? _____ Why do you think as you do? _____

11. Summarize the main points of the goal-insight theory of behavior. _____

12. Give examples of three experiments or studies that have been made which give much support to the goal-insight theory of behavior. Describe each briefly.

(1) _____

(2) _____

(3) _____

13. List six activities that you do nearly the same way each time.

(1) _____ (4) _____

(2) _____ (5) _____

(3) _____ (6) _____

Do you do any of these activities *exactly* the same way twice?

14. Do you think it makes any difference whether a person accepts one theory of how we learn in favor of another theory? That is, is there any chance that it might make a difference in a person's life if he accepted the "goal-insight" theory instead of the "stimulus-response" theory? _____

Defend your answer. _____

Name _____ Date _____ Class _____

IV. TESTING

1. The following phrases indicate ways in which various living things behave. Use your best judgment in deciding which of them might be called instinctive behaviors. Mark those with an *I*. Mark those that you believe to be reflexive with an *R*. Those judged to be habit, with an *H*. Those judged to be insight, or understanding, with a *U*. You may disagree with your fellow students on some of these, so be prepared to defend your answers.

   ____ Man blinking when a sudden movement occurs in front of his eyes

   ____ Dog chasing a cat

   ____ Jumping or starting when an unexpected loud noise occurs near you

   ____ Fish swimming against the current of the stream

   ____ Walking up and down stairs

   ____ Serving a tennis ball accurately across the net

   ____ Removing your finger from a hot stove

   ____ A bee making honey

   ____ Deciding to go to a movie

   ____ Solving a jig-saw puzzle

   ____ Birds migrating

2. What procedures would you follow in training your dog to "say his prayers" (1) if you were to accept the goal-insight theory? _____

   (2) If you were to accept the stimulus-response theory of behavior? _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Write three or four generalizations, or principles of broad application, about the behavior of living things.

Name _____ Date _____ Class _____

UNIT V. PERSONAL AND SOCIAL HEALTH

Chapter 23: The Nation's Health

Although science has held out great possibilities for increased security, health, and happiness for all mankind, this knowledge has not always been used wisely. The state of the nation's health shows clearly the difference between what we know and could do, and what we actually do. In a democracy we have responsibilities not only for our own health, but for that of others. This unit will increase our information about the big problems involved in maintaining and building up our own health and that of others in our nation.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Why is it more important for you and for every other person in a *democracy* to face problems such as national health than it is for individuals living in a dictatorship to face them? _____

2. What are the major "killers" that destroy our people at the present time? _____

3. Diseases of old age (cancer, heart disease, etc.) now kill more persons than ever before. Suggest why this is so. _____

4. Can a child of ten today look forward to a longer life than could a child of ten twenty years ago? _____ What is true of the life expectancy of a man of fifty? _____

5. What problems concerned with personal or national health do you want to consider?

II. EXPLORING

de Kruif, Paul. *Toward a Healthy America.* New York: Public Affairs Pamphlets, No. 31. Public Affairs Committee, Inc. This booklet shows that there is a great lag between the *discoveries* of our life-saving sciences and our *uses* of them.

Charters, W. W., Smiley, Dean F., and Strang, R. M. *Health in a Power Age.* New York: The Macmillan Company, 1941. For a statement about the nation's health, see Units I, III, IV, and V.

Ward, Harold (Ed.). *New Worlds in Science.* New York: Robert M. McBride & Company, 1941. See Sections 6–8 for vivid accounts of virus hunters and the pioneers of medicine.

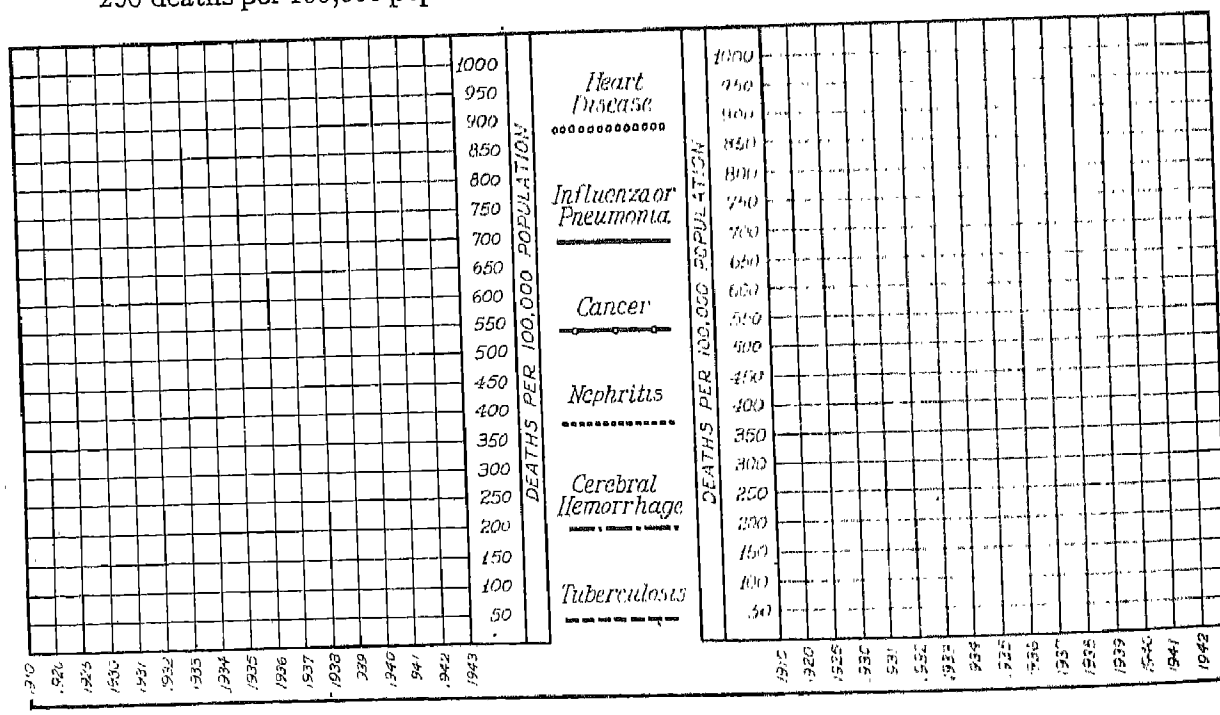
Metropolitan Life Insurance Company. *Calling All Drivers.* New York: Metropolitan Life Insurance Company, 1935. Instructions for safety for automobile drivers.

National Resources Planning Board. *The Problems of a Changing Population.* May, 1938. Superintendent of Documents, U. S. Government Printing Office. The major problems of our human resources are discussed.

Robinson, Victor. *Pathfinders in Medicine.* New York: Medical Life Press, 1929. Biographical sketches of thirty great leaders in science and medicine.

III. DOING AND RECORDING

1. Secure vital statistics for your city or county from your county or state health departments. Use them to prepare graphs showing the rate of increase or decrease of deaths from the major killers over the last twenty to thirty years. Then indicate the rate of increase or decrease of deaths from the same causes for the entire nation. The graph grids below have been prepared for your use, and line symbols have been suggested for each of the chief killers. Vital statistics for the nation may be secured by writing to U. S. Department of Commerce, Bureau of the Census, Division of Vital Statistics, Washington, D. C. National death rates are calculated on the basis of the number of deaths for each 100,000 of population. You will need to calculate death rates in your community on the same basis. If, for example, you live in a community of 2,000 population and there were 5 deaths from cancer in 1940, you would need to divide 100,000 by 2,000, giving 50, and then multiply 5 by 50. In other words, 5 deaths per 2,000 is in the same ratio as 250 deaths per 100,000 population. Tell what each grid shows after preparing the graph.



Name _____ Date _____ Class _____

How do death rates of your community compare with those of the nation as a whole?

_____

2. Are the chief killers for one age group the same as those for another age group?_____

   What killers show up in all age groups? _____

   _____

3. What are the chief killers for your age group? _____

   _____

4. What is meant by "life expectancy?" _____

   _____

   _____ Is it increasing or decreasing? _____

5. Explain why the life expectancy of a man of 50 has not increased greatly during the last forty years? _____

   _____

   _____

6. Explain why diseases of the heart have taken increased toll of life over the last forty years. _____

   _____

   _____

7. Invite a local health authority to talk to your group about local health problems. If this is impossible, organize a committee to visit a local health headquarters and report its findings to the group. Summarize important points in the space below. _____

   _____

   _____

   _____

   _____

   _____

   _____

IV. TESTING

1. What are the chief killers for your age group? _____

2. What are the chief killers when all groups are considered together? _____

3. How have deaths in recent years from automobile accidents ranked among all other causes of deaths for your age group? _____ What measures could your age group take to help in cutting down the death rate from automobile accidents in your community? _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Write a short summary of health problems in your own community. Do the same for the nation as a whole. Attach your summaries to this page. Be sure to indicate the trends suggested by these problems.

Name _____ Date _____ Class _____

Chapter 24: Man's Fight Against Disease

You have heard certain diseases referred to as "catching." Perhaps you "catch" colds and other diseases easily. Health problems affect all of us. This chapter will equip you to face them more intelligently.

I. DRAWING ON WHAT YOU ALREADY KNOW

Answer each of the following questions either by writing what you recall from previous reading or by indicating your most intelligent guess. In Section V you will have opportunity to revise these answers.

1. What are *communicable* diseases? _____

_____

2. What is the *germ theory* of disease? _____

_____

3. Are there theories today, other than the germ theory, that attempt to explain the causes of communicable diseases? If so, tell briefly what they are. _____

_____

_____

_____

4. In the space provided below, state briefly what you think is the cause of each of these common communicable diseases.

Athlete's foot: _____

Common cold: _____

Malaria: _____

Pneumonia: _____

Smallpox: _____

Typhoid fever: _____

5. What are some of the ways by which the diseases listed above are spread? _____

_____

_____

II. EXPLORING

Park, W. H. *Who's Who Among the Microbes.* New York and London: D. Appleton-Century Company, Inc., 1929. A semi-technical discussion of the common microbes, with special emphasis on man's practical use of his knowledge of them.

de Kruif, Paul. *Microbe Hunters.* New York: Harcourt, Brace and Company, 1926. Who first thought that microbes must have parents? Spallanzani did. Pasteur, Koch, Ehrlich, and others also had ideas about the menace of microbes. Paul de Kruif tells you about these scientists.

de Kruif, Paul. *Men Against Death.* New York: Harcourt, Brace and Company, 1932. In an intimate and romantic way the author has reported the achievements of a dozen fighters against human disease and death.

Haggard, H. S. *Devils, Drugs and Doctors.* New York: Harper and Brothers, 1929. A very good study of doctors and their practices throughout history.

Metropolitan Life Insurance Company. *Health Hero Series.* New York: Metropolitan Life Insurance Company. Brief descriptions and pictures of the men who have made outstanding contributions to our knowledge of keeping healthy.

Smith, Geddes. *Plague on Us.* New York: Commonwealth Fund, 1941. How diseases attack man and how man fights diseases.

Vallery-Radot, R. *Life of Pasteur.* New York: Garden City Publishing Co., 1941. An exciting and accurate biographical account of Pasteur's personal and scientific life.

Howard, Sidney. *Yellow Jack.* New York: Harcourt, Brace and Company, 1934. A very exciting play dealing with the history of man's struggle to discover and combat the cause of yellow fever.

Eckstein, G. *Noguchi.* New York: Harper and Brothers, 1931. A lively biography of the great Japanese scientist who made outstanding contributions to our knowledge of spotted fever, yellow fever, syphilis, and other diseases.

III. DOING AND RECORDING

1. Prepare a report on the history of one communicable disease from earliest records of it to the present time. Include a discussion of its present status; its cause, if known; the methods by which it is transmitted; and the controls or methods of prevention now known and practiced. Report may be given in class. Attach a summary of your report to this page of your work book.

2. Using your text and other references, summarize the important contributions to our present knowledge of communicable diseases that were made by each of the following men.

Leeuwenhoek: _____

_____

_____

Semmelweis: _____

_____

_____

_____

Name _____ Date _____ Class _____

Pasteur: _____

Lister: _____

Koch: _____

Theobald Smith: _____

Ronald Ross: _____

Walter Reed: _____

3. List several different kinds of pathogenic (disease-causing) organisms. Describe each briefly as to appearance, and name one disease caused by each.

Disease-causing organism	Appearance	Disease

4. Disease-causing organisms are difficult to see under the type of optical microscope ordinarily available for use in high school classes. Bacteriologists use what are known as oil-immersion lenses in their study of bacteria. If possible, obtain and examine prepared slides. Sketch the appearance of these tiny organisms in the space below. Name each kind that you draw.

5. A number of interesting experiments may be performed in the laboratory by growing bacteria on a food material known as agar medium. It is a good idea to prepare a number of agar media at one time. To do so you will need the following materials:

agar-agar .....10 grams
beef extract....10 grams
peptone.....10 grams
salt.....10 grams
water.....1000 cc.
small amount of baking soda

Place the agar-agar in a large pan or beaker. Add the water and heat slowly, stirring occasionally, until the agar-agar is dissolved. Then add the beef extract, peptone, and salt. Continue stirring until dissolved. Test the broth with red litmus paper. The broth should be slightly alkaline. If the red litmus paper does not turn blue (the test for an alkaline solution), add a very small pinch of baking soda until it does.

Pour test tubes about one third full of the agar medium. Plug the mouths of the tubes with cotton. Sterilize the tubes and their contents by heating in a pressure cooker or other steam sterilizer. Tubes of culture media, so prepared, will keep for a long time if kept in a cool dark place. Sterilize also twice as many Petri dishes as you have tubes of culture media.

When you are ready to do an experiment, heat as many tubes of the media as you need in boiling water until the media are dissolved. Remove the plug of sterile cotton and pour about half the contents of one tube into a sterilized Petri dish. Pour the remainder into another Petri dish. Immediately replace the lids so that contamination will not occur. Allow the culture media to cool. They are then ready for inoculation with bacteria.

Name _____ Date _____ Class _____

If you have been careful in preparing your culture media, no bacteria are present. Try inoculating them (1) by exposing the cultures to the air at various places, (2) by running a dirty finger over the surface, (3) by washing the finger carefully and then passing it over the surface, (4) by sneezing into a culture, and (5) by allowing a fly to walk over the surface. These are suggested experiments, but it will be much more fun for you to set up a number of your own. You may care to try the effectiveness of antiseptics, for example. After inoculating your cultures keep them in a warm, dark place. A shaded 40-watt light bulb burning in a small box makes a good incubator. Bacteria grow best at about body temperature. Write up each experiment, using an outline somewhat like the following one.

Purpose of experiment:

Procedure:

Results and conclusions:

6. Recall that some protozoa cause diseases. Arrange and carry through an experiment to determine the relative effectiveness, in killing protozoa, of several commercial "antiseptics" and "germicides," including iodine, mercurochrome, and alcohol. Protozoa may be obtained from a hay infusion. In order that this experiment may be worth while, think it through carefully before starting work. Write up one experiment and your results in the space below. Attach to this page summaries of your other experiments.

Purpose of experiment: _____

_____

Procedure: _____

_____

Results and conclusions: _____

_____

_____

_____

IV. TESTING

1. Define the following terms in such a way as to indicate how they differ one from another.

(1) Aseptic: _____

_____

(2) Antiseptic: _____

(3) Germicide: _____

_____

2. What are Koch's postulates or rules?

(1) _____

_____

(2) _____

(3) _____

(4) _____

_____

State briefly the importance of Koch's rules. _____

_____

3. Which would be harder to study and control, a virus or a bacterium? _____

Why? _____

4. Are most kinds of germs harmful? _____ Explain your answer. _____

_____

_____

V. SUMMARIZING

1. Reread the answers you wrote in Section I. If any of them need to be corrected or modified, do so now.

_____

_____

_____

_____

2. Indicate what you consider to be the most important concept of this chapter.

_____

_____

_____

Name _____ Date _____ Class _____

Chapter 25: Preventing and Combating Disease

Now that the causes of different diseases are better understood, the problem of preventing and combating them becomes the real challenge. In this chapter you will learn some of the ways in which that challenge is being met.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. What are the best things that we can do to prevent catching colds? _____

2. What are the best things that we can do to combat colds once we have caught them?

3. How is our body equipped to defend us against disease germs? _____

4. What is meant by "inoculation" and what is its purpose? _____

5. What other questions concerned with the prevention or cure of disease would you like to have answered?

II. EXPLORING

de Kruif, Paul. *The Fight for Life*. New York: Harcourt, Brace and Company, 1938. Chapter XII is a romantic account of the development and use of *fever machines*. The fight against tuberculosis, infantile paralysis, and several other diseases is described.

Hill, Justina. *Germs and the Man*. New York: G. P. Putnam's Sons, 1940. A fascinating account of the antics of germs in our system— with especially good directions on how to destroy them.

Rice, Thurman B. *Living*. Chicago: Scott, Foresman & Co., 1940. A complete and enlightening discussion of the causes and cures for certain common diseases.

Dietz, David. *Medical Magic*. New York: Dodd, Mead and Company, 1938. For the war on contagion, see Part VII; for an account of the X-Ray, see Part VIII.

Heiser, Victor. *An American Doctor's Odyssey*. New York: W. W. Norton & Company, Inc., 1936. The adventures of a doctor who traveled in forty-five countries, carrying medical knowledge, doing research, and making valuable observations.

Health Information Pamphlets. New York: Metropolitan Life Insurance Company. *The Conquest of Typhoid Fever, Smallpox Is Still Here, Measles, Whooping Cough, A Message of Hope About Cancer*, and others.

Ross, Martin. *Your Tonsils and Adenoids*. New York: D. Appleton-Century Company, Inc., 1926. What they are and how to take care of them, with emphasis on the relation of diseased tonsils to other diseases.

Hertzler, A. E. *The Horse and Buggy Doctor*. New York: Harper and Brothers, 1938. The autobiographical account of a successful doctor of the mid-west. Changes in medical practices are described, and the rough and ready experiences of the country doctor are told in anecdotal form.

III. DOING AND RECORDING

1. Using prepared microscope slides, photomicrographs, or diagrams study the structure of the human skin and mucous membranes. Sketch a section through the skin showing the parts that may be found there. Label all parts.

2. The mucous lining of the nose and throat is composed of millions of cells which possess cilia. The following experiment, performed on a frog, will enable you to observe the action of cilia and better to determine their function in the human mucous lining.

   Kill a frog by destroying the brain (pithing it) in the following manner. Bend the head down toward the belly. Find, at the base of the skull, the region where the spinal column connects with the skull. Run a blunt dissecting needle into that region as far as it will go and wiggle it back and forth. This is painless to the frog and destroys the brain. Now cut off the top of the head, by cutting back at the angles of the mouth. Leave the lower jaw intact.

Name _____ Date _____ Class _____

Place the frog on its belly and keep the body, mouth, and throat moist with a very weak salt solution. To observe the action of the cilia, place very small pieces of cork on the mucous membrane at the base of the throat. Observe what happens over a period of five minutes. Summarize or sketch your observations in the space below.

3. Examine a small section of the mucous membrane of the frog under the low power of a microscope. Sketch what you observe in the space below.

4. Explain how the mucous membranes of the throat and nose help to prevent disease germs from entering the human body. Be sure to indicate how the cilia help.

_____

_____

_____

5. Examine the contents of a white-headed pimple under the microscope. Remember that it is dangerous to open pimples, because cells are often bruised or destroyed and infection may spread. Therefore, wash the skin with alcohol, use sterile instruments, and clean the fingers before opening a pimple to secure pus for this experiment.

   Place a small amount of the pus on a microscope slide. Smear this into a thin sheet by running the edge of another slide along the length of the slide containing the pus. Place a drop of stain or ink on the slide. Examine, first using low power lens of microscope. Then use the high power lens. Sketch and label what you see.

6. Obtain a drop of human blood, making sure that the needle and surface of the skin where the puncture is to be made are absolutely sterile. Use alcohol to sterilize both. Place blood on slide and smear in same manner as directed in the preceding exercise. Stain with a drop of ink. Can you distinguish between red and white corpuscles? _____ Sketch a few phagocytes at the top of the next page.

Phagocytes:

What is the function of phagocytes? _____

_____

_____

7. Three results are possible whenever the blood or tissues are invaded by germs. What are they?

   (1) _____

   (2) _____

   (3) _____

8. In what ways may microorganisms affect the body to produce the symptoms of a disease? _____

_____

_____

_____

9. Explain how the body protects itself against microorganisms that have invaded the skin. _____

_____

_____

_____

10. Explain how the body protects itself against the toxins produced by microorganisms.

_____

_____

_____

_____

11. What is the difference in meaning between the terms "antibody" and "antitoxin"?

_____

_____

_____

Name _____ Date _____ Class _____

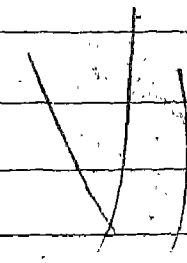
12. Explain the action of vaccines in protecting the body against disease. _____

13. What is meant by active immunity? _____

    Explain how the body develops active immunity. _____

14. What is meant by passive immunity? _____

    Explain how this type of immunity is provided. _____



15. How is an antitoxic serum prepared? _____

16. Explain what is meant by a "bacteriophage." _____

17. What is chemotherapy? _____

18. List several of the activities or services provided by Public Health Departments of modern cities. Draw circles around those that are provided by your community.

19. Why are sulfanilamide, neosalvarsan, and chaulmoogra oil called specifics?

IV. TESTING

1. List all the things you have tried in attempting to cure a cold. If any of these measures were effective draw a circle around them.

2. How do you intend to treat colds in the future?

3. What "do's and "don't's" can you suggest in helping to prevent pimples and in otherwise caring for the skin.

Name _____ Date _____ Class _____

4. What is the modern theory of tooth decay? _____

How, in view of this theory, can tooth decay be prevented? _____

What does the fact that tooth decay can be prevented mean to people who have low incomes? _____

5. In a medical sense, what is a carrier? _____

Why is a carrier particularly dangerous?

6. What is meant by specific immunity? _____

How is specific immunity developed? _____

7. As a citizen in a democracy, what can you do to promote better health in your community?

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, make the necessary changes now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which from your study, observations, reading, and discussions, you believe to be true regarding the problem of preventing and combating disease.

Name _____ Date _____ Class _____

Chapter 26: The Care of Injuries

Many deaths have resulted from the attempts of well meaning but poorly informed persons to provide first aid in cases of sickness or accident. In this chapter we shall try to learn some fundamental "do's" and "don't's" of first aid.

I. DRAWING ON WHAT YOU ALREADY KNOW

The following situations are similar to ones that you may actually encounter. Read carefully the part of each paragraph that tells what first aid measures were used. Tell whether, in your opinion, those measures were good or bad, and give your reasons for evaluating them as you do.

1. Two young men were driving down a highway streaked with packed snow and ice. Suddenly another car flashed past them, careened on for a few hundred yards, turned over and over, and finally crashed into a ditch. The two young men stopped their car and rushed to the wrecked one. The sole occupant of that car was unconscious, badly cut, and bleeding. They quickly picked him up, carried him to their car, put him in the front seat, and rushed him to a hospital. Upon arriving at the hospital, the injured man was dead. The hospital attendants, after examining the victim, asserted that he might have lived had he been given proper care following the accident. List the things that should have been done and tell what should *not* have been done in the above situation.

2. Two boys were hiking when one fell and received a deep cut in his forearm near the elbow. The blood flowed in spurts. The other applied a tourniquet to the arm between the cut and the wrist and bandaged the cut itself. What would you have done in a similar circumstance? Why? _____

3. A man's leg was broken in an automobile accident and the jagged end of the bone pushed through the skin. Friends in the same car, recognizing the danger of infection, pushed the bone back through the skin and attempted to set the broken leg, applying boards to form a splint. They then took the injured man to a doctor's office. What would you have done in a similar circumstance? Why? _____

_____

_____

_____

_____

_____

4. A small child reached into the medicine cabinet, secured a bottle of carbolic acid, and drank some of it. The child's cries allowed its mother to see, immediately, what had happened. She quickly forced raw egg whites down the child's throat and then gave it some soapy water to drink. Finally she gave the child a big dose of castor oil. In the meantime her husband had called the doctor. What would you have done in a similar circumstance? Why? _____

_____

_____

5. What questions concerning the care of injuries would you like to have answered?

_____

_____

_____

_____

II. EXPLORING

Handbook for Boys. New York: The Boy Scouts of America. Very clear and accurate directions for first aid treatment.

Girl Scout Handbook. New York: Girl Scouts, Inc. First aid methods are included in several sections of this handbook.

American Red Cross First Aid Text-Book. Philadelphia: The Blakiston Company, Inc., 1937. Careful and reliable instructions for first aid treatment of all the common accidents.

Pope, C. H. *Snakes Alive and How They Live*. New York: The Viking Press, 1937. An excellent discussion of venoms and of snake bites and their treatment will be found in Chapters XVIII and XIX.

Kallet, Arthur M., and Schlink, F. J. *100,000,000 Guinea Pigs*. New York: The Vanguard Press, 1933. A discussion of some of the poisons we sometimes buy and unknowingly eat.

Schlink, F. J. *Eat, Drink and Be Wary*. New York: Covici, Friede, 1935. An amazing account of poisons in many of the foods which we eat.

Aaron, Harold. *Good Health and Bad Medicine*. New York: Consumers Union of United States, Inc., 1940. Chapter I tells what first aid treatments are effective for minor injuries and poisoning.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. Using your text and the American Red Cross *First Aid Text-Book*, study the nature of fractures, and the proper first aid treatment for simple and compound fractures. Have a member of the class who has had Red Cross or Scout first aid instruction demonstrate the correct treatment of fractures. Write up your notes and attach them to this page.

2. Using your text and the American Red Cross *First Aid Text-Book*, study the nature of flesh wounds. Discuss them in class. Explain or demonstrate proper procedures in each situation indicated below. Use the space provided for your notes.

   (1) How can you determine whether an artery or a vein has been cut? _____

   _____

   (2) Flesh wounds are subject to two dangers: infection and severe bleeding. How would you stop arterial bleeding in the following regions?

   Head: _____

   _____

   _____

   Arm: _____

   _____

   _____

   Leg: _____

   _____

   _____

   (3) Describe the use of a tourniquet, discussing the dangers of its use as well as the advantages. Be sure to tell how long a tourniquet may be left before being loosened and why it should be loosened. _____

   _____

   _____

   _____

   _____

(4) Describe the treatment of a flesh wound to lessen the danger of infection. Would you apply treatment to a mere scratch? _____

_____

_____

_____

(5) Would your treatment for a surface cut be the same as that for a deep puncture wound, for example, one received from stepping on a nail? _____ Why? _____

_____

_____

What should always be done when a puncture wound is received? _____

_____ Why? _____

_____

_____

3. What would constitute a general treatment for internal corrosive poisoning? _____

_____

_____

_____

_____

_____

4. Reports should be given to the class on the nature and treatment of shock, burns, and asphyxiation. Shock is common and often fatal in accidental injuries. The American Red Cross *First Aid Text-Book* is perhaps the best reference to use. Use the space below to place your summary of these reports.

Shock—Causes and nature: _____

_____

_____

Symptoms: _____

_____

_____

Name _____ Date _____ Class _____

Treatment: _____

_____

_____

_____

_____

Burns—Treatment of acid burns: _____

_____

_____

Treatment of alkali burns: _____

_____

_____

Treatment of first, second, and third degree burns caused by heat: _____

_____

_____

_____

_____

_____

Asphyxiation—Causes: _____

_____

Treatment: _____

_____

_____

5. Ask an instructor from the American Red Cross or one of your local doctors to teach you the Prone Pressure method of artificial respiration. Have the class pair off in pairs of girls and pairs of boys and practice giving artificial respiration to each other. This practice should be taken seriously and failure to receive a passing grade at the end of the instruction period should be the basis for further practice and also for individual instruction.

6. Invite an instructor of the American Red Cross to address the class and demonstrate the care and treatment of accidental injuries. This will be of most value to you if you have done some careful studying of first aid prior to the talk. Use the space below for notes. *Remember that first aid is immediate and temporary treatment only, and that a physician should be called unless the injury is known certainly to be very slight.*

7. In your community what foods are most likely to be sources of metallic poisons? Use the reports found in Consumer's Research Bulletins. Also write for a copy of the Federal Food, Drug, and Cosmetic Law. How can you safeguard yourself against such poisons?

8. Prepare a report on *allergies*. Periodicals, books, and encyclopedias from your local library should give you the information about allergies that you need. Attach your report to this page.

9. Describe the effect of each of the following sedatives on the human body.

Narcotic:

Anesthetic:

Hypnotic:

10. What function is served by pain?

Name _____ Date _____ Class _____

11. Summarize the development of knowledge concerning the relief of pain in surgery.

IV. TESTING

Answer the following questions without referring to your notes. They are questions for which you should know the right answers without using references or other help.

1. If one of your friends should break an arm while playing in the school yard, what first aid should you give?

2. How should a sprained ankle be cared for?

3. How should a minor cut or scratch be cared for?

4. How should a deep cut which bleeds freely but steadily be cared for?

5. How should a cut from which the blood spurts be cared for? _____

6. Tell what you would do for a person who apparently had swallowed a poison, the nature of which you did not know. _____

7. What materials do you consider necessary for an adequately equipped First Aid cabinet?

V. SUMMARIZING

1. Reread your answers to the questions in Section I. If they need to be corrected or modified, do so now.

2. How would you now answer those questions which you yourself raised in Section I?

3. State two principles of universal application concerning first aid.

Name _____ Date _____ Class _____

Chapter 27: You and the Nation's Health

Now that we have studied the development of man's knowledge of diseases and know something of the cause and prevention of communicable diseases, let us return to a study of the major killers. The prevalence of these killers in our own communities is a matter of personal concern to everyone of us. This chapter will help you to determine what is being done and what should be done to improve conditions in your community and in the nation.

I. DRAWING ON WHAT YOU ALREADY KNOW

You probably have some idea of the correct answers to most of the following questions. Yet you may find it necessary to do considerable study and research to answer some of them satisfactorily. For the present, answer them as best you can with the knowledge you now possess. In Section V you will be given opportunity to revise these answers.

1. What are the symptoms that might indicate the presence of cancer? _____

2. How should cancer be treated? _____

3. Why do poverty and tuberculosis tend to go together? _____

4. What are the main functions of the United States Public Health Service? _____

5. Does your community have a slum or housing problem? If so, describe it briefly. ____

6. Does your community have adequate public health services? _____ Outline briefly the chief measures employed by local organizations. _____

7. What are, or should be, the functions of a community Department of Health? _____

8. If you have any questions about your community health problems or about national health problems, write them in the space below.

Name _____ Date _____ Class _____

II. EXPLORING

You may wish to explore some phase of community and national health beyond the discussion given in Chapter 27. The following references should help you in doing this. Pamphlets, bulletins, and other publications of your local, county, state, and national health organizations and the vital statistics reports of the Division of Vital Statistics, Bureau of the Census, at Washington, D. C., are among the most valuable references for your study.

de Kruif, Paul. *Men Against Death.* New York: Harcourt, Brace and Company, 1932. Don't forget this good book about a dozen famous leaders in the fight against disease in man.

de Kruif, Paul. *Why Keep Them Alive?* New York: Harcourt, Brace and Company, 1936. The tragic case of millions of children who are not fed because it costs money to eat.

de Kruif, Paul. *Microbe Hunters.* New York: Harcourt, Brace and Company, 1926. The story of men of science who thought microbes had parents and that they caused disease.

de Kruif, Paul. *Toward a Healthy America.* Public Affairs Pamphlet, No. 31. New York: Public Affairs Committee, Inc. Tells how we should overcome the slow pace of health improvement.

de Kruif, Paul. *Health is Wealth.* New York: Harcourt, Brace and Company, 1940. A new slant on the necessity for health—to save the public's money.

Fishbein, Morris. *Shattering Health Superstitions.* New York: Liveright Publishing Corp., 1930. This is an exposition of false theories and notions in the field of health and popular medicine.

Health Pamphlets, "Hearing," "Good Teeth at All Ages," "Health Throughout the Ages." New York: Metropolitan Life Insurance Company.

The Work of the United States Public Health Service. Washington: U. S. Government Printing Office, 1940. A report on the wide range of activities of our national health service which will help you to know how you can best work with it for better national health.

Stewart, Maxwell S. *America's Children.* Public Affairs Pamphlet, No. 47. New York: Public Affairs Committee, Inc. A discussion of the health, housing, educational, religious, and other needs of our young people.

Amidon, Beulah. *Who Can Afford Health?* Public Affairs Pamphlet, No. 27. New York: Public Affairs Committee, Inc. This report, based on the National Health Survey, tells how many sick people there are, and who can afford to have medical help.

Facts You Should Know About Health Cures. New York: Better Business Bureau, Inc. Several common health ailments, with warnings on the dangers involved in self-treatment.

Colean, Miles L. *Can America Build Houses?* Public Affairs Pamphlet, No. 19. New York: Public Affairs Committee, Inc. Since the health of the nation depends largely upon its houses, it is important that you know about the prospects for a larger number of better houses in America. This book helps you to understand that good houses are possible if communities, through planning, become "good housing" conscious.

Wood, Edith E., and Ogg, Elizabeth. *The Homes the Public Builds.* Public Affairs Pamphlet, No. 41. New York: Public Affairs Committee, Inc. This pamphlet will help you to understand rural and city housing problems just as Bill and Mike were helped to understand them from the expert, Mr. King.

III. DOING AND RECORDING

1. Why has the death rate from cancer increased in recent years? _____

_____

_____

_____

2. Investigate the work of the American Society for the Control of Cancer. Are there offices of this organization in your community? If so, secure a committee report on its work. Summarize this report and attach your summary to this page.

3. What is your community death rate from pneumonia and influenza? _____ Summarize in the space below the information about these two "killers" that can be read from the graph on page 164 of this workbook. _____

4. What is your community death rate from tuberculosis? _____ If statistics are available, determine what parts of the community have the highest and what parts have the lowest death rate. Can you suggest the probable reasons for these differences? _____

What can be done about the tuberculosis problem in your community? Good references for answering this question can be secured from the offices in your county of the National Tuberculosis Association. _____

5. Make a list of good mental health habits and another of bad mental health habits.

Good Mental Health Habits	Bad Mental Health Habits

Name _____ Date _____ Class _____

6. Investigate hospitalization and medical insurance plans in your own or in a nearby community. How do these plans impress you? Are they sound? On what grounds are such plans fought by pressure groups? Are the arguments of these pressure groups sound? You might have a panel discussion of these questions by members of the class. Summarize your findings in the space below.

IV. TESTING

1. Encircle the letter in front of all endings in each group which correctly complete the incomplete statement. There may be more than one correct ending in each group.
   (1) The death rate from heart disease and cancer is increasing because
      a. our diet is not as good as it used to be.
      b. we do not exercise sufficiently.
      c. communicable diseases are being controlled so that we live longer.
      d. medical science knows less about these diseases than it once did.
      e. these are diseases of "old age."
   (2) Cancer
      a. is not a major killer today.
      b. can be cured by surgery, radium, and X-rays.
      c. can be cured by the above methods and others as well.
      d. symptoms are bleeding or colored discharges from the body, sores that do not heal, lumps that change in size or appearance, difficulty in swallowing not due to colds or known sources of irritation, warts and moles that change in size and appearance or become tender.
      e. is a bacterial disease.
   (3) The death rate from tuberculosis is higher in slum areas than in other areas because people in slum areas
      a. live in more congested surroundings.
      b. are born with a tendency to contract tuberculosis that is greater than that of most other people.
      c. are not apt to have adequate, well rounded, protective diets.
      d. are apt to be overworked, and to have too little fresh air, exercise, and sunshine.
      e. are often financially unable to secure proper medical attention and physical examinations.

2. Are the symptoms discussed in (2), d *sure* signs that a person has cancer? _____
Explain. _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. Then indicate here any changes, additions, or corrections that you now need to make.

2. How would you now answer those questions which you yourself raised in Section I?

3. State any generalizations which, from your study, observations, reading, and discussion, you believe to be true regarding the health of your community and of the nation.

Name _____ Date _____ Class _____

UNIT VI. THE DEVELOPMENT AND IMPROVEMENT OF LIVING THINGS

Chapter 28: How Living Things Change

Through the millions of years since plant and animal life appeared on the earth, many changes have occurred. Some present-day animals bear resemblance to animals now extinct. The present-day horse, for example, has some of the characteristics of early species which have entirely disappeared. In this chapter we will consider some of the kinds of changes which occur in plant and animal life.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will be given opportunity to correct or modify these answers.

1. How do we know that forms of life, now extinct, once existed on the earth? _____

_____

_____

2. What are fossils? _____

_____

3. Is there any evidence that living things are changing today? _____ Give evidence to support your answer. _____

_____

_____

4. Outline, if you can, some of the stages in the development of the dog or of some other animal about which you have read. _____

_____

_____

_____

5. Has change in living things occurred in a gradual fashion, in a sudden fashion, or in both ways? _____ Why do you think as you do? _____

_____

_____

_____

6. List, if you can, some modern animals that seem to be related to ancient forms of life.

_____ _____ _____

_____ _____ _____

7. What other questions concerning change in living things would you like to have answered?

_____

_____

_____

_____

8. As you study this chapter, you will read more in detail about the development of the modern horse. Early horses seem to have been small mammals about the size of the modern cat. These small animals had several toes instead of hoofs. Through millions of years types of animals developed which gradually began to have hoofs. Finally a form of animal developed which was to become the modern horse. State here what hypothesis or theory you have as to the reason such changes have taken place. If you have no basis for making a reasonable hypothesis, make a guess. Check this guess as you study more about change.

_____

_____

_____

_____

_____

II. EXPLORING

Hotchkiss, William O. *The Story of a Billion Years*. New York: Reynal, Hitchcock, Inc., 1933. Changes in earth features and animal life are interestingly described.

Johnson, Gaylord. *How Father Time Changes the Animals' Shapes*. New York: Julian Messner, Inc., 1939. Father Time looks over a little foot-high creature and says, "I'll make it a race horse yet." And he does, as you will see as you read this book.

Ditmars, Raymond L. and Carter, H. *The Book of Prehistoric Animals*. Chicago: J. B. Lippincott Company, 1935. This is a highly colorful children's book telling about the awesome creatures that lived on earth before man. Eight maps in color help you understand when and where the strange animals lived.

Lee, W. T. *Stories in Stone*. New York: Van Nostrand Company, Inc., 1926. Wonderlands of Western America and some of the curious incidents in the history of geology.

Fenton, Carrol Lane. *Our Amazing Earth*. New York: Doubleday, Doran & Company, Inc., 1938. Chapters XXII–XXVIII tell the exciting story of the development of life on earth, and Chapter XXIV has a valuable time chart called "Calendar of Earth's Ages."

Reed, Maxwell. *The Earth For Sam*. New York: Harcourt, Brace and Company, 1928. The story of mountains, rivers, dinosaurs and men, written for boys and girls.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. List here four examples of deliberate change which man has brought about in his domesticated plants and animals.

_____

_____

_____

_____

Does it seem possible that some such changes might have been occurring by chance throughout geologic time? _____ Tell why you think as you do. _____

_____

_____

2. After you have read and learned more about records of the past, give some examples of animals which have been fully or partly preserved as fossils.

Animals *partly* preserved as fossils: _____

_____

_____

Animals preserved *intact:* _____

_____

_____

3. What have been some of the chief factors in bringing about plant and animal changes in the past? _____

_____

What animals probably were the direct predecessors of birds? _____

Are there any types of plants from the distant past which still exist today? _____ If so, name some of them. _____

_____

Why are the fossils of plants and animals which are found in rocks at great distances below the surface of the earth thought to be older than those found nearer the surface?

_____

4. In Chapter IV you were asked to find and record in a table the approximate number of years which had elapsed since certain things had happened on the earth. Such knowledge has come largely through a study of fossils found in rocks that were laid down in successive geological eras. To help you gain a better knowledge of this geological history, find the information called for in the accompanying chart. In the third column indicate for each *Era* the dominant types of plant or animal life; for each *Period* or *epoch* the first appearances of plant or animal life.

Geologic Era, Period, or Epoch	Approximate number of years ago	Era: dominant types of life. Period or epoch: first appearances of life species	Surface and temperature changes
ARCHEOZOIC ERA			
PROTEROZOIC ERA			
PALEOZOIC ERA			
Cambrian Period			
Silurian Period			
Devonian Period			
Carboniferous Period			
Permian Period			
MESOZOIC ERA			
Triassic Period			
Jurassic Period			
Cretaceous Period			
CENOZOIC ERA			
Eocene epoch			
Oligocene epoch			
Miocene epoch			
Pliocene epoch			
Pleistocene or Glacial epoch			
Recent or Post-glacial epoch			

Name _____ Date _____ Class _____

5. Describe briefly the changes which have occurred in the development of the horse, beginning with Hyracotherium.

Stages in the development of the horse	Main pliysical characteristics during each stage
Hyracotherium	
Eohippus	
Orohippus	
Epihippus	
Mesohippus	
Miohippus	
Parahippus	
Merychippus	
Hipparion	
Protohippus	
Pliohippus	
Equus complicatus	
Equus caballus	

6. A remark frequently heard in discussions about fossils is, "This is a piece of petrified tree; the wood is turned to rock," or "This animal has turned into stone." What is incorrect in such a statement? _____

_____

_____

7. Look up the meaning of *index fossil* in a geology book. Then try to determine whether any index fossils have been found in your community. You may need to write to your state geologist or state university to find out about regions in your state where fossils have been found. Report your findings here. _____

_____

_____

_____

_____

IV. TESTING

1. On the blank after each of the following items, place the name of the geologic era, period, or epoch to which the item most closely relates.

First period of glaciation _____
Formation of present coal beds
_____
First amphibians _____

Earliest known man _____
When huge ferns lived in temperate zone
_____
Equus complicatus _____

2. Does geological evidence of change seem to indicate that change is catastrophic or gradual? _____ Explain. _____

_____

_____

3. Are fossils found in rocks of the oldest, or Archeozoic, Era? _____

What does the term "Archeozoic" mean? _____

_____

4. In what two major ways has evidence of the existence of living things been preserved?

_____ and _____

V. SUMMARIZING

1. Look over the answers which you wrote to the questions in Section I. If they need to be corrected, make the necessary changes now.

_____

_____

_____

2. How would you now answer those questions which you yourself raised in Section I?

_____

_____

_____

3. Are you satisfied with the hypothesis concerning change which you wrote in Section I? If not, how would you now state it?

_____

_____

Name _____ Date _____ Class _____

Chapter 29: How Man Promotes Changes in Living Things

Man, more than any other living thing, controls and changes his environment. He is always eager to make changes which are useful to him. He even tries to hasten the natural process of change. And he succeeds in doing so in many ways. In this chapter we will learn how man changes living things.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to change or modify these answers.

1. How is it possible for two black rats to be parents of a white rat? _____

2. What is "hybrid" seed corn? _____

3. Is it possible to predict with any degree of accuracy what color the offspring of a black rat mated to a white rat will be? _____ Explain. _____

4. How does *inbreeding* differ from *hybridization?* _____

5. How can environment influence the development of a plant which under optimum conditions should grow tall, bear much fruit, and be disease resistant? _____

6. Does your state have a plant experiment station? _____ An agricultural experiment station? _____ If so, where are they? _____

_____

7. What other questions, concerned with ways in which man promotes changes in living things, would you like to have answered?

_____

_____

_____

II. EXPLORING

Burbank, Luther. *Partner in Nature.* New York: D. Appleton-Century Company, Inc., 1939. New kinds of flowers, fruits, and berries were produced by the genius of Burbank. In this personal account he tells how his work was accomplished.

de Kruif, Paul. *Hunger Fighters.* New York: Harcourt, Brace and Company, 1928. A vivid description of the life and work of the men who improved wheat, corn, and meat.

Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran & Company, 1934. On pages 600–628 the authors discuss the ways in which plants and animals improve. For an explanation of hereditary laws, see pp. 459–513.

Dunn, L. C. *Heredity and Variation.* New York: The University Society, Inc., 1934. A technical, but simply written, description of the fundamental heredity processes. A good source of examples of how our knowledge is used in breeding experiments.

Darwin, Charles. *The Variation of Plants and Animals Under Domestication.* New York: D. Appleton-Century Company, Inc., 1896. Darwin describes the differences in such animals as the pig, the cat, and the horse under domestication as compared with their wild brothers.

Price List 38—37th Edition. Animal Industry—Farm Animals, Poultry and Dairying. Price List 44—35th Edition. Plants—Culture of Fruits, Vegetables, Grain Grasses and Cereals. List of publications relating to these subjects, for sale by Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

III. DOING AND RECORDING

1. In order to get an idea of the large number of living things which man has deliberately set out to change, make a list of some of the plant and animal changes which have resulted from plant and animal breeding experiments.

Plants	Animals

Name _____ Date _____ Class _____

2. What evidence can you find among members of your class that there is variation among living things? To help you answer this question, do the following:
   (1) Using a piece of string and a ruler, measure the size in inches of each student's wrist. Record the results.

Boys' wrists	Girls' wrists
____, ____, ____, ____, ____, ____,	____, ____, ____, ____, ____, ____,
____, ____, ____, ____, ____, ____,	____, ____, ____, ____, ____, ____.

   (2) Count the number of students who have distinctly blue eyes, the number who have distinctly brown eyes, and those who have eyes of other colors.

   Number of students with brown eyes: _____ Number of students with blue eyes: _____ Number of students with eyes of other colors: _____

   What do you conclude about variation in eye color? _____

   _____

   (3) Have five boys and five girls go to the blackboard and draw outlines of their left hands. How do the hand shapes and sizes vary? _____

   _____

   _____

   (4) Pick a dozen leaves from the same region on an old tree and compare the size and shape of the leaves. How do they compare? _____

   _____

   What conclusions can you draw from the above observations about variation in living things? _____

   _____

   What is meant by variation? _____

   _____

3. What is mean by hybridization? _____

   _____

   Outline the steps necessary to obtain a hybrid type which is desired. _____

   _____

   _____

Make a list of plants and of animals which are hybrids.

Plants	Animals
_____	_____
_____	_____
_____	_____
_____	_____

4. In order to become familiar with the famous experiments performed with pea plants by Gregor Mendel, indicate the kind of peas which Mendel obtained by each of the following four crosses.

   Let S stand for Smooth
   Let w stand for wrinkled

   Which characteristic is *dominant?* _____

   (1.) SS×ww (_____ crossed with _____)

   First generation: _____ _____ _____ _____ Description: _____

   _____

   (2.) Sw×Sw (_____ crossed with _____)

   Offspring: _____ _____ _____ _____ Description: _____

   _____

   (3.) ww×ww (_____ crossed with _____)

   Description of offspring: _____

   _____

   (4.) SS×SS (_____ crossed with _____)

   Description of offspring: _____

   _____

5. From his experiments Mendel obtained evidence which he used as a basis for stating the laws of heredity in peas. The laws have been found to apply to inheritance in many other organisms. Explain what Mendel meant by each of the following terms which he used to describe hereditary behavior.

   (1) Unit character: _____

   _____

Name _____ Date _____ Class _____

(2) Determiners: _____

_____

(3) Dominance: _____

_____

(4) Recessiveness: _____

_____

6. Is the Mendelian ratio something that is predetermined or does it occur by chance?

_____

A coin-flipping session will help you to see how chance enters into the occurrence of events. Have each student in class flip a penny one hundred times. Record the number of "heads" and the number of "tails" which occur for each student.

Students	*Students*	*Students*
No. 1 ___ H ___ T	No. 11 ___ H ___ T	No. 21 ___ H ___ T
No. 2 ___ H ___ T	No. 12 ___ H ___ T	No. 22 ___ H ___ T
No. 3 ___ H ___ T	No. 13 ___ H ___ T	No. 23 ___ H ___ T
No. 4 ___ H ___ T	No. 14 ___ H ___ T	No. 24 ___ H ___ T
No. 5 ___ H ___ T	No. 15 ___ H ___ T	No. 25 ___ H ___ T
No. 6 ___ H ___ T	No. 16 ___ H ___ T	No. 26 ___ H ___ T
No. 7 ___ H ___ T	No. 17 ___ H ___ T	No. 27 ___ H ___ T
No. 8 ___ H ___ T	No. 18 ___ H ___ T	No. 28 ___ H ___ T
No. 9 ___ H ___ T	No. 19 ___ H ___ T	No. 29 ___ H ___ T
No. 10 ___ H ___ T	No. 20 ___ H ___ T	No. 30 ___ H ___ T

What is the ratio of total number of heads to total number of tails in this experiment? _____ Is the ratio more nearly equal for each individual student's trials or for the group as a whole? _____

7. If peas with yellow seedcoats are crossed with peas with green seedcoats, the results show that yellow color is *dominant*. Show by drawing or diagram the color of the seedcoats and the character of the *determiners* for both a first generation and a second generation of crossing.
Use Y for yellow and y for green.

YY×yy (_____ crossed with _____)

Description of first generation: _____

Yy×Yy (_____ crossed with _____)

Description of second generation: _____

8. Sometimes individual seeds of peas carry two characters. For example, there are Yellow-Round peas and green-wrinkled peas. How can you show the results of each of these crosses?

(1) Yellow-Round YYRR × green-wrinkled yyrr

(2) Yellow-Round YyRr × Yellow-Round YyRr

Use the space below to work out the combination of characters resulting from these crossings. Describe the appearance of each group of offspring.

9. There are many complex hereditary situations because the characters which are transmitted from one generation to another are not always distinctly dominant or recessive. If two characters are equally effective in influencing the offspring, then a new type of character may appear. This is true with the cross between a purebred black Andalusian chicken and a purebred white Andalusian. The offspring are blue-gray in color. They are called blue Andalusians. This situation is called *blending*.
Show by use of symbols how this may result:

BB (black) × WW (white)

Show what would be the result in the next generation.

BW × BW

10. What is meant by *inbreeding?* _____

_____

What are some of the advantages of inbreeding? _____

_____

_____

_____

Name _____ Date _____ Class _____

11. Even though a plant or animal is carrying the hereditary characteristic for some special trait, frequently this trait will not develop unless proper environmental conditions are present. By referring to genetics books find what environment is essential to produce the trait described for each organism below.

(1) Corn seed growing into a stalk of corn: _____

_____

(2) Development of certain kinds of cancer in mice: _____

_____

(3) Change of the salamander (Axolotl) from a water-living animal to a land animal (Amblystoma): _____

_____

(4) Development of green chlorophyll in plants: _____

_____

What do the above observations indicate about the importance of environment?

_____

IV. TESTING

1. If a black-coated rat should mate with a white-coated rat and the offspring are all black, which color trait is dominant? _____

How do you know? _____

_____

2. If the young black rats in Question 1 grew up and mated, what types of offspring would you expect? _____

_____

_____

3. Suppose you wanted to raise white rats and you started with the offspring of the black rat and the white rat in Question 1. Explain what you would do to secure a group of purebred white rats. _____

_____

_____

4. Explain why it might be possible for two black-coated rats to be the parents of a white-coated rat, if black coats are dominant over white. _____

5. How is it possible for plant and animal breeders to make use of individual variation in improving living things? _____

V. SUMMARIZING

1. Reread your answers to the questions in Section I. Then indicate here any changes, additions, or corrections that you now wish to make. _____

2. How would you now answer those questions which you yourself raised in Section I?

3. Write at least three generalizations which you believe are important with regard to man's promotion of changes in living things. _____

Name _____ Date _____ Class _____

Chapter 30: How Living Things Change Without the Influence of Man

You have now learned that change takes place, that living things change throughout time, and that man has learned some ways by which he can promote change to his own advantage. However, long before man was present on the earth, changes were taking place. Fossils reveal the fact that living things through long periods of time have changed from simple to more complex forms as we know them now. Several theories or explanations have been advanced to account for these changes. You will learn about some of them in this chapter.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each question write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. What facts can you cite as evidence that later species of living things are descendants of earlier and, perhaps, less highly developed species? _____

2. Can stages in the development of the embryos of vertebrate animals be used as evidence that living forms of today have developed from simpler forms of the past? _____

   Why? _____

3. What meaning do you attach to the expression "survival of the fittest"? _____

4. What is meant by "the inheritance of acquired characteristics"? _____

5. What other questions about change in living things would you like to have answered?

II. EXPLORING

Parker, Bertha Morris, and Fenton, Carroll Lane. *Life Through the Ages.* Evanston, Illinois: Row, Peterson and Company, 1942. A 36-page booklet which tells the story of life on the earth as the story of change.

Parker, Bertha Morris, and Riggs, Elmer S. *Animals of Yesterday.* Evanston, Illinois: Row, Peterson and Company, 1941. In this 36-page booklet stories read from fossils are interestingly told.

Romer, Alfred Sherwood. *Man and the Vertebrates.* Chicago: The University of Chicago Press, 1937. This book gives a fascinating account of the backboned animals, including the main steps in their evolutionary story.

Fenton, Carroll Lane. *Life Long Ago.* New York: Reynal & Hitchcock, Inc., 1937. This story of fossils records the history of the ancestors of our present animal life.

Reed, William Maxwell, and Lucas, Jannette May. *Animals on the March.* New York: Harcourt, Brace & Co., Inc., 1937. Incorporates the geography of the changing world.

Peattie, Donald Culross. *This Is Living.* New York: Dodd, Mead & Company, 1938. This view of nature, with photographs, describes the wonders of everyday life.

Lucas, Jannette May. *Man's First Million Years.* New York: Harcourt, Brace & Co., Inc., 1941. A delightful book on anthropology and archaeology.

III. DOING AND RECORDING

1. What are some of the specific pieces of evidence that have been found in fossils to show that living things have changed, and that later species have descended from earlier species?_____

2. List at least five vestigial organs and tell what possible function the organ or its arrangement in the animal may have served in some earlier organism.

Vestigial structure	Function in earlier organism

What conclusion is drawn by persons who have studied vestigial organs with regard to explaining their presence? _____

Name _____ Date _____ Class _____

3. Explain what is meant by the *recapitulation theory*. _____

_____

_____

4. What does the word *homologous* mean? _____

_____

Name four homologous organs found in various common animals. Then tell how homologous organs have been used as evidence that existing life developed from simpler forms.

_____ _____ _____ _____

_____

_____

5. In the table below summarize the important points in each of the theories named.

Theory of—	Essential points of the theory
Natural selection	
Inheritance of acquired characters	
Mutations	

6. See if you can find at least four examples of mutations. List them below.

_____ _____

_____ _____

7. If possible,dissect a cat and a rabbit to obtain the appendix from each. A human-anatomy model may be available to use in studying the appendix of man. How do rabbit, cat, and human being compare in size? How does the appendix of each compare in size with the other two? Account for the facts that you observe. Attach your report to this page.

IV. TESTING

1. What are the three most widely known theories which purport to account for change in living things?

   (1) _____

   (2) _____

   (3) _____

2. State the chief ways in which the theories, which you named in the preceding question, differ one from another. _____

3. Taking all evidence into consideration, what theory or combination of theories seems to you to offer the best explanation as to how change in living things takes place? _____

V. SUMMARIZING

1. Reread the answers you wrote to the questions in Section I. Make any necessary additions or corrections now.

2. How would you now answer those questions which you yourself raised in Section I?

3. Write any conclusion or generalization which you believe would hold true with regard to explanation of change in living things.

Name _____ Date _____ Class _____

Chapter 31: Biological and Cultural Inheritance

There are few persons who would deny the importance of both biological and cultural inheritance in making people what they are. However, there is much discussion and controversy as to the relative importance of each. Examine carefully whatever evidence is presented in your text and reference readings. Then you will be better able to judge for yourself the extent to which biological inheritance influences living things and the extent to which environmental factors influence them.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best that you can do in answering some of them. In Section V you will be given opportunity to revise these answers.

1. How is red hair inherited? _____

2. What is the purpose of the sperm cells and egg cells in living things? _____

3. What are some behavior traits that people probably cannot pass on *physically* from one generation to another? _____

4. What is meant by intelligence? _____

5. How is intelligence measured? _____

6. What influence does environment have in molding the development of a growing boy or girl? _____

7. Select some foreign country. Then make a statement about the kind of person you probably would be if you were growing up in that country. _____

_____

_____

_____

_____

_____

_____

8. What other questions about inheritance would you like to have answered?

_____

_____

_____

_____

_____

II. EXPLORING

Scheinfeld, Amram. *You and Heredity.* New York: Frederick A. Stokes Company, 1939. A cleverly illustrated book for beginners in the study of heredity.

Altenburg, E. *How We Inherit.* New York: Henry Holt and Company, Inc., 1928. Clearly written, not difficult, with emphasis upon the personal implications of heredity.

Gesell, Arnold. *The Wolf Child.* New York: Harper and Brothers, 1941. A fascinating description of a girl who was reared by a wolf and who then lived for nine years among human beings. An authentic story.

Huntington, Ellsworth. *Tomorrow's Children.* New York: John Wiley and Sons, Inc., 1935. This book answers nearly four hundred of the most often asked questions about heredity and genetics. Simply written and accurate.

Huntington, Ellsworth. *The Red Man's Continent.* New Haven: Yale University Press, 1919. Although a chronicle of aboriginal America, the relation of climate to health and the influence of geographical conditions on life are so interestingly and clearly told that the book makes a highly valuable contribution to the understandings developed in your biology text.

Keliher, Alice. *Life and Growth.* New York: D. Appleton-Century Company, 1941. The entire book gives helpful information about human behavior but Chapters I–IV are especially fine on this subject.

U.S.D.A. Yearbook, 1940. *Farmers in a Changing World.* Washington: U. S. Government Printing Office. "Cultural Anthropology and Modern Agriculture" Part V, p. 983, discusses the nature of communities.

Wells, Huxley, and Wells. *The Science of Life.* New York: Doubleday, Doran and Company, 1934. The ABC of genetics is discussed on pp. 459–513.

Rice, Thurman B. *Living.* Chicago: Scott, Foresman & Company, 1940. This book deals honestly and sanely with questions of inheritance. Simply and clearly written.

Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. In a sentence explain what is meant by each of the following.

   Biological inheritance: _____

   _____

   Cultural inheritance: _____

   _____

2. What is meant by the word *chromosome?* _____

   _____

   Each animal species possesses a specific number of chromosomes. See if you can find from a genetics book the number of chromosomes possessed by each of these animals:

   Fruit fly (Drosophila) _____ Man _____
   Chicken _____ Dog _____
   Frog _____ Earthworm _____

   How many chromosomes are possessed by each sperm cell in man? _____ By each egg cell? _____ When the two cells unite, how many chromosomes are in the resulting organism? _____ By what process does the new organism receive just half as many chromosomes as the sum of those possessed by both the egg and sperm cells?

   _____

3. It is known that *black eyes* are dominant over *blue eyes* and that *dark hair* is dominant over *light hair*. Let us see what combinations might result if various crosses were made between parents possessing different characteristics.

   BB will stand for black eyes. DD will stand for dark hair.
   bb will stand for blue eyes. dd will stand for light hair.

   Is it possible through *reduction division* to get genes with the following characteristics?

   Sperms—BD Bd bD bd Eggs—BD Bd bD bd

   What would the children resulting from the following crosses be like in regard to the color of their eyes and hair? How many types of hair and eye color would there be? _____ How many of each type? _____

   _____

   1. BD×BD
   2. BD×Bd
   3. BD×bD
   4. BD×bd
   5. Bd×Bd
   6. Bd×bD
   7. Bd×bd
   8. bD×bD
   9. bD×bd
   10. bd×bd

4. There are a number of hereditary traits that are known to be transmitted from one generation to another as *unit characters*. What is meant by a unit character? _____

_____

5. Can you list four human traits that are thought to be transmitted as unit characters?

_____ _____

_____ _____

What are some characteristics or traits that probably are not transmitted as unit characters? List six.

_____ _____

_____ _____

_____ _____

6. Indicate a number of human traits, other than those listed, which are commonly considered as behavior traits.

Cooperation _____ _____ _____

Courtesy _____ _____ _____

_____ _____ _____

What evidence is there to show that such characteristics *are* or *are not* inherited?

_____

_____

_____

7. What is meant by *Intelligence Quotient* or I. Q.? _____
_____ If a person has a Mental Age of 18 and a Chronological Age of 15, what is his I. Q.? _____

Describe any evidence that you know of to show whether or not two persons with exactly the same mental ability (if such were possible) would have the same measurable I. Q. if one of them had been raised in an intellectually stimulating environment and the other among very backward surroundings. _____

_____

_____

_____

Name _____ Date _____ Class _____

8. After considerable reflection, write a definition for each of the following words.

Nationality: _____

_____

Ethnic: _____

_____

9. Study references on heredity and anthropology to find discussions about individuals of the same nationality brought up under different conditions. For example, Chinese brought up in China and in Hawaii, or Italians brought up in Italy and in New York. After you have read at least one such study, summarize the findings and conclusions in the space below. _____

_____

_____

_____

_____

_____

_____

_____

10. Prepare a list of ten to fifteen men and women who have made great contributions to the fields of human knowledge—science, music, art, mathematics, invention, statesmanship, etc. Do you find many ethnic and national groups represented? _____ Use the following space and continue your outline at the top of page 218.

Person's name	Nature of his contribution	Ethnic, national, or racial membership

Person's name	Nature of his contribution	Ethnic, national, or racial membership

11. If possible, arrange for a social worker or housing expert to talk to the class on the problem of providing better environments for all people in the community. Attach a report of the talk to this page.

IV. TESTING

1. Can the antisocial traits of the Kallikaks and the Jukes be entirely explained on the basis of poor biological inheritance? _____ Why? _____

2. What is the importance of cultural inheritance in determining behavior patterns?

3. Which appears to you to be the more effective way to improve the human race—to improve the biological or the cultural inheritance? _____

   Defend your answer. _____

Name _____ Date _____ Class _____

4. Tell what you would do in the following situation, and why.

   A farmer heard that by crossing white short-haired goats with black curly-haired goats he would get a flock of black curly-haired goats. He wanted such a flock because the price for the hair would be greater than that for white curly hair. So he crossed black curly-haired females with white short-haired males. But all of the offspring were white and short haired. He had them all killed for meat. What should he have done and why?

5. Read each of the following statements carefully. If you agree with the statement, place the letter *A* before it. If you disagree, place the letter *D* there. If you are uncertain, use the letter *U* to indicate your uncertainty.

   _____ It is possible for a white cat to have black kittens.
   _____ Red hair tends to run in families.
   _____ A child is certain to be musical if, before his birth, his mother plays the piano.
   _____ It is no one else's business whom any person marries.
   _____ Criminal tendencies are not inherited.
   _____ Individuals who look alike may have offspring who differ greatly in appearance.
   _____ Identical twins possess the same hereditary makeup.
   _____ The Intelligence Quotient is always the same for a given person.
   _____ A person with a low mental capacity may get along in the world just as well as a more intelligent person.
   _____ There is no convincing evidence that psychological differences are necessarily related to physical differences.

6. A boy placed sawdust in each of two small boxes. In one he planted yellow peas. In the other he planted green peas. After watering both he placed a glass plate over the yellow peas and set the box on a window sill in the classroom. He placed the other in a dark storeroom. Each day he examined both boxes. After four days, he made the following observations:
   "The yellow peas in the box in the classroom grew. The green peas in the dark room did not grow. The sawdust in the box with the green peas was driest."

   Conclusions which the boy drew:
   (1) Seeds do not need air for germination.
   (2) Green peas require more moisture than yellow peas.
   (3) Green peas do not germinate as quickly as do yellow peas.
   (4) Peas need light for germination.

Criticize both the experiment and the conclusions. Tell how you could set up experiments to check the conclusions.

V. SUMMARIZING

1. Reread your answers to the questions raised in Section I. If they need to be corrected or modified do so now.

2. How would you now answer those questions which you yourself raised in Section I?

3. What conclusions or generalizations do you believe to be true with reference to the relative importance of biological and cultural inheritance?

Name _____ Date _____ Class _____

UNIT VII. THE MAINTENANCE OF KIND

Chapter 32: Reproduction—To Maintain the Stream of Life

That living things have existed for many ages has been established beyond debate. That many changes have occurred in plant and animal life during that time is a generally accepted truth. In the chapter dealing with hereditary processes you saw how certain characteristics can be passed along from parent to offspring. In this chapter you will consider problems concerned with reproduction, the process by which plants develop from plants and animals develop from parent animals.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. How does reproduction occur in plants? _____

2. Can you distinguish between *sexual* and *asexual* reproduction in plants? What advantages can you suggest in each case? _____

3. Can you tell what the process of reproduction is in bacteria? _____

4. What is meant by cross-pollination in plants? _____

5. What other questions concerned with reproduction would you like to have answered?

II. EXPLORING

Brown, William H. *The Plant Kingdom.* Boston: Ginn and Company, 1935. How plants reproduce by means of the flower, Chapter XIII, also the production of seeds and fruits, Chapter XIV.

Quinn, Vernon. *Seeds—Their Place in Life and Legend.* New York: Frederick A. Stokes Company, Inc., 1936. An excellent book about how seeds are adapted for living, and their practical uses as foods and in drugs.

Levine, Milton I., and Seligman, Jean. *The Wonders of Life.* New York: Simon and Schuster, Inc., 1941. This simple and remarkable book on how we are born and how we grow up was written especially for boys and girls.

Keliher, Alice. *Life and Growth.* New York: D. Appleton-Century Company, Inc., 1938. The story of the development of human beings, written for young people.

De Schweinitz, Karl. *Growing Up.* New York: The Macmillan Company, 1935. The story of reproduction simply told.

Davenport, Charles B. *How We Came by Our Bodies.* New York: Henry Holt and Company, Inc., 1936. A discussion of how the human body develops and how heredity plays a part in the make-up of the individual. Chapter VI begins an excellent discussion of the *cell* later followed by a study of tissue—all in relation to the human body.

Ets, Marie Hall. *The Story of a Baby.* New York: The Viking Press, 1939. Describes aspects of the growth and development of a baby with a good description of early social development. Good for young people.

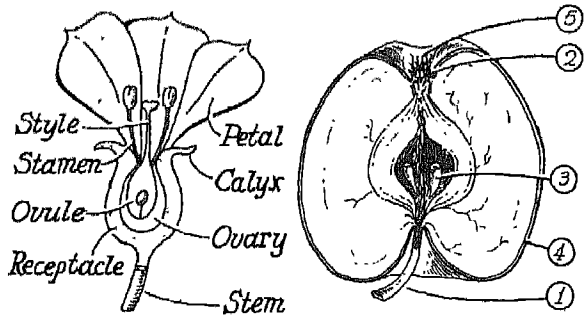
III. DOING AND RECORDING

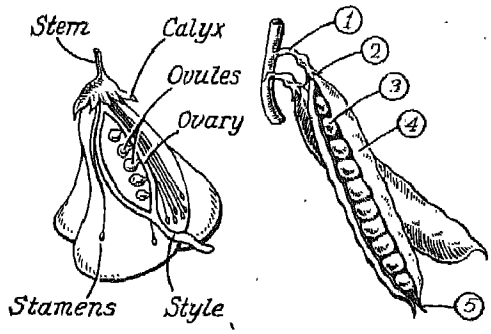
1. Obtain a fresh flower and study the parts. Petunias or morning glories are good for this study. Then, by means of a drawing, indicate the parts of the flower observed and tell the function of each part.

Function

Name _____ Date _____ Class _____

2. Examine an apple and a pea pod carefully. Show that you can tell the relationship of the parts to the original flowers by writing the number of each fruit part after its corresponding flower part.





3. Some kinds of plants have separate male and female flowers. Sometimes the male (staminate) and female (pistillate) flowers are on the same plant; sometimes on different plants. When the male and female flowers are on the same plant, the plant is called _____; when male and female flowers are on separate plants, the plants are said to be _____. Give several examples of both types of plants, indicating which type each example is.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

4. Answer each of the following questions as clearly and concisely as you can.

(1) What is meant by pollination? _____

_____

(2) By self-pollination? _____

_____

(3) By cross-pollination? _____

_____

5. Corn is a monoecious plant. If possible, obtain a stalk of corn upon which "tassels" and "ears" are developing. Seeds planted in a tub twelve weeks earlier will yield good specimens for this exercise. Otherwise secure drawings or models. Study each part carefully and then answer the following questions.

Which part is the female flower? _____

What flower structures are the silks? _____

What do the ovaries become? _____

Where is pollen produced? _____

Why do corn silks extend outside the husk? _____

_____

Why are "tassels" on the upper part of the corn stalk? _____

_____

How does pollination occur in corn? _____

_____

6. What is meant by a composite flower? _____

_____

Give the names of at least five composite flowers.

_____ _____

_____ _____

_____ _____

7. Flowers have many adaptations to aid or insure cross-pollination. Briefly describe three of these adaptations. _____

_____

_____

_____

_____

_____

How many sperms are produced in each pollen grain? _____ Where are the egg cells in a flower produced? _____

Name _____ Date _____ Class _____

8. What name do we apply to the process by which a sperm cell unites with an egg cell?

_____

9. If possible, secure a female fish. Examine the ovaries. Are there eggs present? _____
Record observations as to number, etc. _____

_____

_____

10. How are the eggs of fish fertilized? _____

_____

If possible, visit a fish hatchery to learn about the methods used in propagating fish. Attach a report of your visit to this page.

11. Reproduction may occur both in plants and in animals without involving fertilization. Such reproduction is called *asexual* reproduction. It is easy to observe asexual reproduction in bacteria. Place some nutrient agar media in each of ten (or more) Petri dishes. Place the dishes in an autoclave and sterilize for an hour. After they are cooled, expose eight of them to various sources of bacteria. The others may be needed in the next experiment. Exposure may be accomplished by (1) blowing breath on one, (2) exposing one to classroom air for ten minutes and another for thirty minutes, (3) exposing to air in hall during classes, (4) exposing to air in hall as students are passing, (5) laying two hairs across agar, (6) touching agar with fingertips, etc. Keep the dishes warm and examine them from time to time. Record your observations below.

Culture media exposed to:	Approximate number of bacteria colonies after:			
	4 hours	1 day	2 days	3 days
1. Breath				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

12. Make a *pure culture* by transferring some of the bacteria to a medium in another sterile Petri dish. Use a needle which you have sterilized by heating in a flame. Touch the needle to one of the bacteria colonies and then touch to the surface of the sterile medium. Do not raise the cover entirely off the dish, merely tilt it and draw the needle gently across the surface of the agar. Place this dish in a warm place and observe from day to day. What are your results? _____

13. Describe briefly each one of the following asexual methods by which animals and plants reproduce. Give several examples of animals or plants which reproduce by the method named.

(1) Fission: _____

_____

Examples: _____

_____

(2) Regeneration: _____

_____

Examples: _____

_____

(3) Budding (in plants): _____

_____

Examples: _____

_____

(4) Grafting: _____

_____

Examples: _____

_____

14. What are the advantages of asexual reproduction? _____

_____

_____

Of sexual reproduction? _____

_____

_____

_____

15. Visit a nursery or greenhouse. Have a person in charge describe the various methods of plant propagation used. Attach your report to this page.

Name _____ Date _____ Class _____

IV. TESTING

1. What is the distinction between a *complete* flower and a *perfect* flower?

2. What are the advantages of cross-pollination?

3. Name four methods of asexual reproduction.

4. What are some of the practical uses of asexual reproduction in improving man's own well-being?

5. In the following exercise underline the one word which is best defined by the numbered definition which precedes it.

   (1) A process of producing new individual organisms.
   pollination reproduction sterilization respiration

   (2) The part of a typical flower which *receives* the pollen grain.
   anther stigma corolla ovary petal

   (3) A plant which has separate male and female flowers on the same plant.
   monoecious plant dioecious plant composite complete flower

   (4) The male sex cell.
   sperm pollen grain anther egg ovary

   (5) Process by which a sperm unites with an egg.
   pollination germination fertilization spontaneous generation

(6) Process by which yeast plants reproduce.
fission budding conjugation regeneration sterilization

(7) The process by which bacteria multiply rapidly.
fission budding conjugation regeneration sterilization

(8) An example of asexual reproduction.
conjugation fertilization sporulation hatching

(9) Process of cutting and fitting a twig to a branch of a different variety of tree.
budding conjugation grafting pollinating seeding

(10) Process by which a part of an animal will develop new parts or an entire organism from one small part.
grafting regeneration sporulation fertilization

V. SUMMARIZING

1. Reread the answers you wrote to the questions in Section I. If they need to be corrected or modified do so now.

2. How would you now answer those questions which you yourself raised in Section I?

3. In the space below write some general principles which you have learned about reproduction in plants and in animals.

Name _____ Date _____ Class _____

Chapter 33: How Plants and Animals Grow from Egg to Adult

Methods by which the fertilized eggs of different animals develop are in some ways very much alike and yet there are many interesting variations. Chickens *hatch* from eggs, but cats and dogs are *born* from a mother parent. Insects *hatch* from eggs, as do some snakes. How do these different animals compare in their development from the egg stage until they become adults. How does their development compare with human development? In this section these questions will be considered.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. An intelligent guess may be the best you can do in answering some of them. In Section V you will have opportunity to revise these answers.

1. Can you name some animals that have a period of infancy?

   _____ _____ _____

   _____ _____ _____

2. Can you name some animals that have no period of infancy?

   _____ _____ _____

   _____ _____ _____

3. What is the purpose of the yolk in eggs? _____

   _____

4. How is the embryo of viviparous animals fed before birth? _____

   _____

5. What is your present belief about the possibility of a human mother's thoughts influencing or "marking" her child before birth? _____

   _____

   _____

6. Name ways in which plants give "parental" care to their offspring.

   _____

   _____

   _____

   _____

7. What other questions concerned with the development and growth of plants or animals do you wish to have answered?

_____

_____

_____

_____

II. EXPLORING

Keliher, Alice. *Life and Growth.* New York: D. Appleton-Century Company, 1938. This book tells in a fascinating manner how the individual grows in a changing world. It affords much practical information for the growing high school boy and girl.

Sanger, Margaret. *What Every Boy and Girl Should Know.* New York: Coward-McCann, Inc., 1927. This book tells to young people, candidly, cleanly, and scientifically, what science has to say about sex life and sex conduct.

Levine, Milton I. and Seligman, Jean. *The Wonders of Life.* New York: Simon and Schuster, 1941. A simple and remarkable book on how we are born and how we grow up · written especially for young people.

Chase, Stuart. *What the New Census Means.* Public Affairs Pamphlet, No. 56. New York: Public Affairs Committee, Inc. In simple language you are given a picture of the two possible future · results of our declining birth rate and increasing prospects for long life.

Bell, Howard N. *Youth Tell Their Story.* Washington, D. C.: American Council on Education, 1938. A study of the attitudes and conditions of young people in Maryland between the ages of 16 and 24.

National Resources Planning Board. *Population Statistics.* October, 1937. Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. (1) National Data, 30 cents. (2) State Data, 25 cents. (3) Urban Data, 15 cents.

III. DOING AND RECORDING

1. Make a list of five different animals which you have seen when newly born, and tell briefly the general appearance of each upon first coming into the world. Include in your list some of the invertebrates.

Animal	General appearance of newly born young
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Name _____ Date _____ Class _____

2. Among the animals listed in the preceding exercise, there may be some which have no period of infancy, some which are similar in form to adults, and some which, in appearance at birth, differ greatly from adults. After reading your text and other references, name animals which belong to each group.

   (1) No period of infancy: _____ _____

   _____ _____ _____

   (2) Infants similar to adults in form: _____ _____

   _____ _____ _____

   (3) Infants unlike adults: _____ _____

   _____ _____ _____

3. If possible, collect examples of each stage in the life cycle of some insect which has complete metamorphosis. Houseflies, bees, ants, or wasps would be good choices. What is meant by complete metamorphosis? _____

   _____

   _____

   Describe briefly each stage in the development of the insect chosen.

   _____

   _____

   _____

   _____

   _____

   _____

4. The grasshopper passes through only three stages in its development. What kind of metamorphosis does it exhibit? _____ Name the stages in the grasshopper's life cycle, and sketch its appearance at each stage.

   (1) _____

   (2) _____

   (3) _____

5. If this unit is being studied at the time of year when frog's eggs can be secured, allow a mass of them to develop in pond water placed in a container in the classroom. Note the stages in their development from egg to frog. If the eggs are not available, determine the stages through which they pass by consulting your text and other references.

   (1) What stages appear in their development?

   _____, _____, _____, _____

   (2) What kind of metamorphosis does the frog exhibit? _____

   (3) About how long does it take for an egg to develop into an adult frog? _____

   (4) What appears to be the use of the yolk of the frog egg? _____

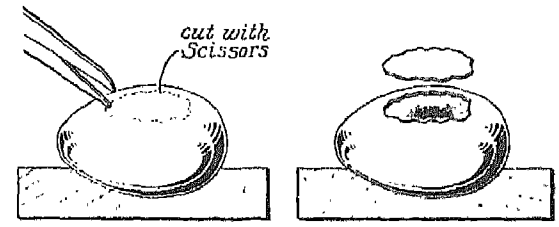
   _____

   (5) Do any amphibians, other than the frog, go through a similar process of development? _____ If so, what are some examples? _____

   _____

6. Secure a homemade or commercial incubator to use in incubating eggs for observation during different stages in the development of a baby chick. If no incubator is available, obtain eggs at various stages in incubation from a local hatchery. Study development in fertile eggs incubated for 36 hours; for 48 hours; for 72 hours; for 10 days; and for 21 days.

   Egg incubated for 36 hours: Place egg upon a warm pad as soon as possible after removing from incubator. Using fine pointed scissors, puncture the shell and then cut a hole on top as shown at the right. Examine the embryo with a good hand lens or a low-power microscope. Be sure to have a good light directed on the embryo. For a clearer view, the egg may be emptied into a small glass dish and the embryo carefully separated from the yolk. The embryo then should be placed in a watch glass or Petri dish for observation.



   Describe some of the characteristics of the embryo at each other stage. Follow approximately the same procedure for specimens representing each incubation period.

   Characteristics of 36-hour embryo: _____

   _____

   Characteristics of 48-hour embryo: _____

   _____

   Characteristics of 72-hour embryo: _____

   _____

Name _____ Date _____ Class _____

Characteristics of 10-day embryo: _____

_____

Characteristics of 21-day embryo: _____

_____

Note: If it is impossible to obtain live chick embryos, use prepared mounts and slides. In any case, mounts and slides are useful supplements to the observation of living specimens, for they usually represent a larger number of stages in development.

7. Study the development of a mammal. The pregnant female white rat is a good animal to select if one can be obtained. (Guinea pig or rabbit may be used.) Kill with chloroform. Using dissecting scissors, open the animal ventrally, exposing the *uterus*. Observe the uterus and its blood vessels. Slit the uterus and expose one of the embryos. Be careful not to rupture the membranes. Next remove the membrane from one embryo. Identify the umbilical cord. How is it connected with the wall of the uterus? Record observations as they are directed by your instructor.

_____

_____

_____

_____

_____

8. What hypothesis can you suggest to explain why certain birds have become adapted for running about and obtaining their own food soon after hatching, while others must be fed by parents? _____

_____

_____

9. Why is it more necessary for human beings to be organized into *families* than for some of the lower animals, such as the cats or snakes, to be so organized? _____

_____

_____

_____

10. Obtain case work reports from social workers in your community or state on the effects of broken homes on delinquency. Summarize some of the findings and attach your summary to this page.

11. Observe people, ranging in age from infants to seventy and over, in your neighborhood and then list activities which appear to be characteristic for the ages given below.

Children under three: _____

Children from three to six: _____

Children from six to eleven: _____

Children from eleven to sixteen: _____

Persons from sixteen to fifty: _____

Persons from fifty to seventy: _____

Persons over seventy: _____

What are some of the activities that overlap from group to group? _____

What relation do you see between the activities of different age groups and the physical development of individuals in those age groups? _____

12. Many adaptations have been developed by plants to insure development of their young from seeds. Give examples of each of the following procedures.

(1) Provision of food for young: _____

(2) Protection of seeds to guard against destruction: _____

(3) Dispersal of seeds: _____

Name _____ Date _____ Class _____

IV. TESTING

1. Five broad generalizations are made below. If you think the generalization is too broad and hence has many exceptions, criticize it by telling how it is not accurate. If you think the generalization is essentially sound, merely write the word *sound* after the statement.

   (1) All living things go through the same stages of development after fertilization of the egg. _____

   _____

   (2) The development of the embryos of all mammals is just about the same for the several weeks immediately after fertilization. _____

   _____

   _____

   (3) The more complex the development of a kind of animal, the more is parental care necessary for that animal. _____

   _____

   _____

   (4) The more complex the development of an animal type, the greater the number of eggs that will be produced by that animal. _____

   _____

   _____

   (5) All reptiles lay eggs and all mammals give birth to their young. _____

   _____

   _____

   _____

2. Answer the following questions.

   (1) What does the name *amphibian* mean? _____

   _____

   (2) What is meant by *degeneracy* in adulthood? Give examples. _____

   _____

   _____

(3) Where does an oviparous animal get its food supply before hatching? _____

What happens to the wastes from its body during its development? _____

_____

(4) How does the embryo of a typical mammal receive food and remove waste? ____

_____

(5) How is the human embryo protected against disease and against injury from the nervous reactions of the mother? _____

_____

(6) Does the general health of the mother affect the health of the developing embryo? _____ Explain. _____

_____

_____

3. Place an X before each ending which correctly completes the incomplete statement. You will find more than one correct ending in each group.

(1) The process of complete metamorphosis

—— has four distinct stages.
—— is represented by all insects.
____ is typified by the development of the housefly.
____ is valuable in helping protect the species in which it occurs.
____ is exhibited by mammals.

(2) In most plants the development

____ from seed to young plant is called germination.
____ of seed is insured by special means of seed dispersal.
____ is similar to incomplete metamorphosis in animals.
____ of a mature plant from every seed is always certain.
____ of a new plant usually can occur without the production or use of seed.

V. SUMMARIZING

1. Reread the answers which you wrote to the questions in Section I. If there are any which need to be corrected, make the necessary changes now.

_____

_____

2. How would you now answer those questions which you yourself raised in Section I?

_____

_____

Name _____ Date _____ Class _____

UNIT VIII. CONSERVATION OF OUR BIOLOGIC WEALTH

Chapter 34: Controlling Pests

Since the number of pests of all kinds—insects, weeds, molds, etc.—is legion, the life of every one of us is influenced by them. Some pests are more common in the country than in the city. Many are common both to country and city. There are so many kinds, with so many ways of being troublesome and with so many self-protection adaptations, that problems concerned with their control become very complex. It is highly important therefore for all of us to become acquainted with a few of the commoner principles of pest control.

I. DRAWING ON WHAT YOU ALREADY KNOW

In the space after each of the following questions write your best *present* answer. In Section V you will have opportunity to revise these answers.

1. Can you tell why automobiles are inspected when they come from Canada into the United States? _____

2. What are the chief insect pests in your community? Indicate methods of control after each one that you name. _____

3. Can you suggest adaptations for self-preservation that are possessed by insects? Indicate one insect that possesses each adaptation that you list.

4. It is sometimes said that the insect menace may become so grave that man himself will be exterminated. What do you think about this? _____

5. What are the common weeds in your community? _____

_____

_____

6. Why are weeds often able to live when other plants die? _____

_____

_____

7. What adaptations enable hawks to see mice from relatively high in the air? _____

_____

8. What other questions concerned with pest control would you like to have answered?

_____

_____

_____

II. EXPLORING

Fabre, Jean H. *Insect Adventures.* New York: Dodd, Mead and Company, 1924. Exciting stories told for young people about bees, wasps, caterpillars, and spiders (which aren't insects!).

Herrick, G. W. *Insect Enemies of Shade Trees.* Ithaca, New York: Comstock Publishing Company, 1935. Insect enemies of shade trees are described and suggestions made for their control.

Howard, L. O. *Fighting the Insects.* New York: The Macmillan Company, 1931. Insect-control is described in a most interesting way in this book.

Fitzpatrick, F. L. *The Control of Organisms.* New York: Bureau of Publications, Teachers College, Columbia University, 1940. A description of the extent and kinds of damage done by insects, together with suggestions for controlling them.

Buchsbaum, Ralph. *Readings in Ecology.* Chicago: The University of Chicago Press, 1940. A thorough and expert account of the problems of the balance in nature.

Sweetman, H. J. *Biological Control of Insects.* Ithaca: Comstock Publishing Company, 1936. An excellent discussion of how to fight insect pests by the use of other insects and by proper agricultural methods.

Price List 41—35th Edition. *Insects.* Bees and Honey, Insects Injurious to Man, Animals, Plants and Crops, Sprays and Spraying, and Insecticides. For a list of available publications related to the above topics, write to Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

Government Bulletins—Secure from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., free *price lists* Nos. 41 and 72. A few typical bulletins and leaflets in these price lists are: Argentine Ant, Bulletin No. 1101. Bedbugs, Leaflet No. 146. Bedbug Supplement, Bulletin No. 129. Flies, Bulletin No. 1408. House Ants, Leaflet No. 147. House Rat, Circular No. 423. Injury to Buildings by Termites, Leaflet No. 101. Mosquitoes, Bulletin No. 1570. Moths, Bulletins Nos. 1353 and 1665. Rat Control, Farmers' Bulletin No. 1533. Ratproofing Buildings, Bulletin No. 1638. Roaches, Leaflet No. 144. Insect Pests in Grain Crops, Farmers' Bulletin No. 835.

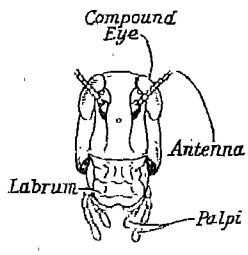
Name _____ Date _____ Class _____

III. DOING AND RECORDING

1. Record the information called for in the following table in order that your knowledge of at least ten common insect pests will be fairly well organized.

Name of Insect	Description of egg	Description of larva	Description of pupa	Description of adult
Housefly				
Mosquito				
Japanese beetle				
Corn borer				
Boll weevil				
Termite				
Codling moth				
Clothes moth				
Cockroach				
Bedbug				

2. The grasshopper is a typical *biting* insect. Study the drawing carefully. Then tell how the grasshopper feeds and how it can be destroyed.



GRASSHOPPER

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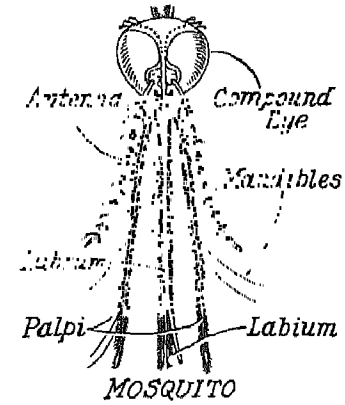
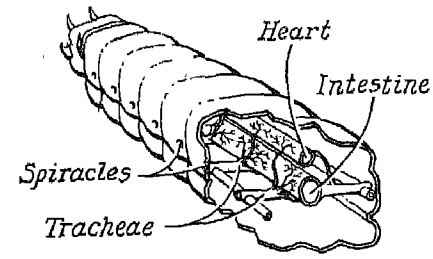
3. The mosquito is typical of *sucking* insects. Study the drawing carefully. Then tell how the mouth parts are adapted for feeding.



MOSQUITO

4. The mouth parts of the housefly differ from those of either the grasshopper or the mosquito. Make a microscopic study of a housefly. Then sketch the fly's mouth parts and tell how they differ from those of the grasshopper or of the mosquito.

5. Some insects can best be destroyed in large quantities by smothering. Study this drawing and then tell how the respiratory systems of insects work.



6. Place the letter C before each of the following substances which are ordinarily used for *contact poisons*. Place S before each that is used for a *stomach poison*.

____ Paris green
____ Arsenate of lead
____ Black Leaf 40
____ Nicotine sulfate solution
____ Soapsuds-kerosene emulsion
____ Derris powder
____ Pyrethrum powder

Name _____ Date _____ Class _____

7. Indicate appropriate methods for destroying each insect pest listed below. Substitute for those listed any which may be particularly harmful in your community. Give specific poison, if poison is used.

Insect pest	Appropriate methods for destroying
Household ant	
Mosquito	
Termite	
Clothes moth	
Bedbug	
Japanese beetle	
Grasshopper	
Cutworm	
Potato beetle	
Aphid	

8. The ladybird beetle has been used as a *biological control* in combating the potato beetle. What is meant by a biological control? _____

_____

Name some other examples of biological controls. _____

_____

9. List six weeds which are troublesome in your community. What adaptations does each have that make it especially troublesome? Indicate effective control measures.

Weed	Troublesome adaptations	Effective control measures

10. There are plant pests other than weeds. A large number of fungi (which are plants) live as *parasites* or as *saprophytes*. What are some of the most destructive of the fungi and how can they be controlled? This exercise will help you to answer that question.

Examine some ripe bread mold. Can you locate some *spores?* If so, describe them.

_____

What is the function of spores? _____

_____

Can you locate some *mycelia?* Describe the appearance of the mycelia. _____

_____

_____

What is the function of a mycelium? _____

_____

Most of the harmful fungi produce spores in vast numbers. What does this suggest with regard to control of fungus pests? _____

What three conditions are necessary for the growth of saprophytic fungi?

_____ _____

_____

11. The following chart will help you organize your information about a number of important fungi. Fill in the spaces, adding others if you can.

Name of fungus	Is this common in your community?	What damage does it do?	How may it be controlled?
Corn smut			
Wheat blight			
Potato blight			
Bread mold			
Mildew			
Athlete's foot			